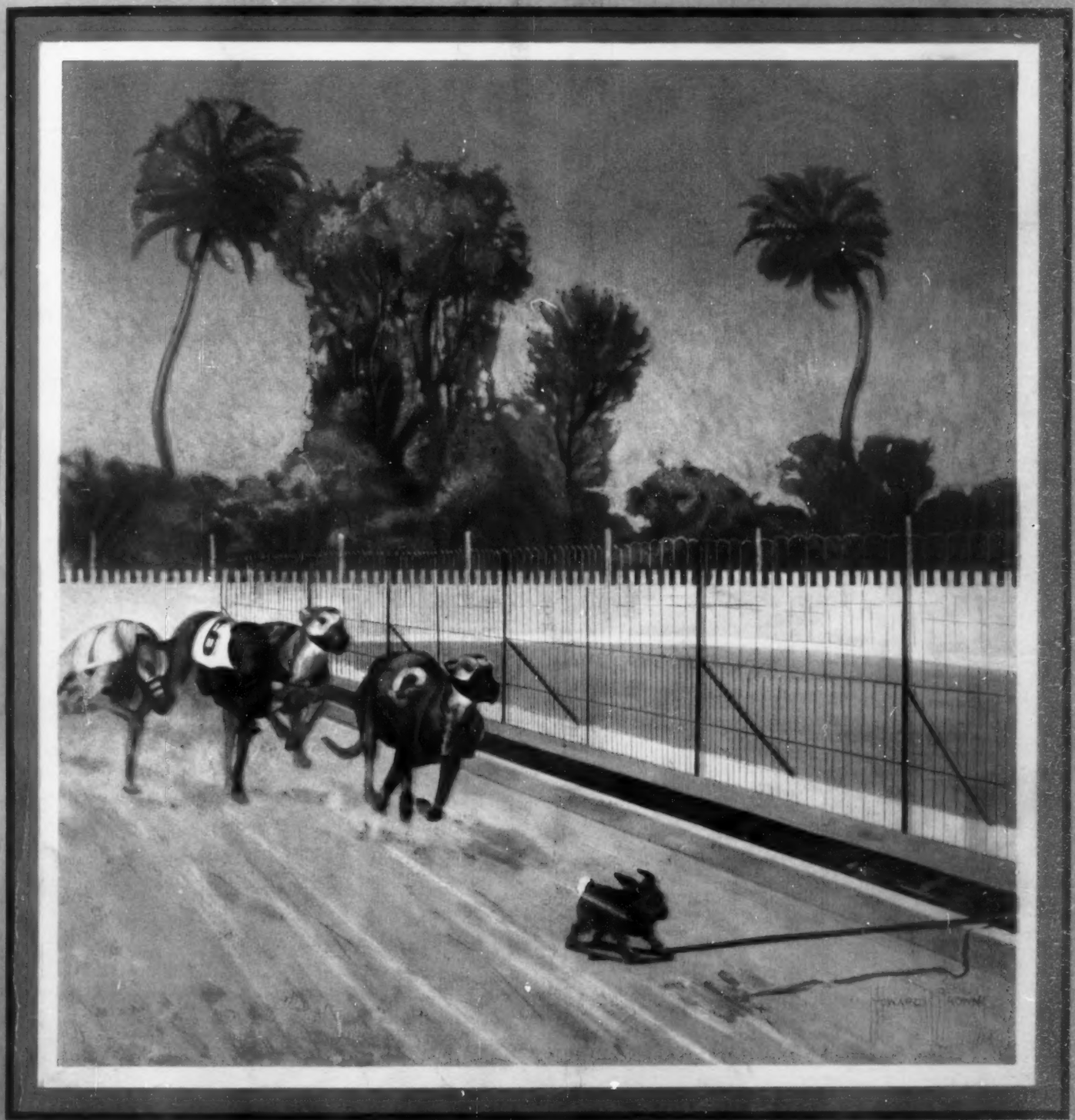
SCIENTIFIC AMERICAN

NATURE'S BUILDING BLOCKS
By Prof. B. S. Hopkins

WHAT IS "L.T.C."?
SANE WEIGHT REDUCTION



A RABBIT THAT CANNOT BE CAUGHT

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FOR MEN who want to become independent in the NEXT TEN YEARS

IN the spring of 1937 two men will be sitting in a down-town restaurant.

"I wonder what's going to happen next year," one of them will say. "Business is fine now—but the next few years are going to be hard ones, and we may as well face the facts."

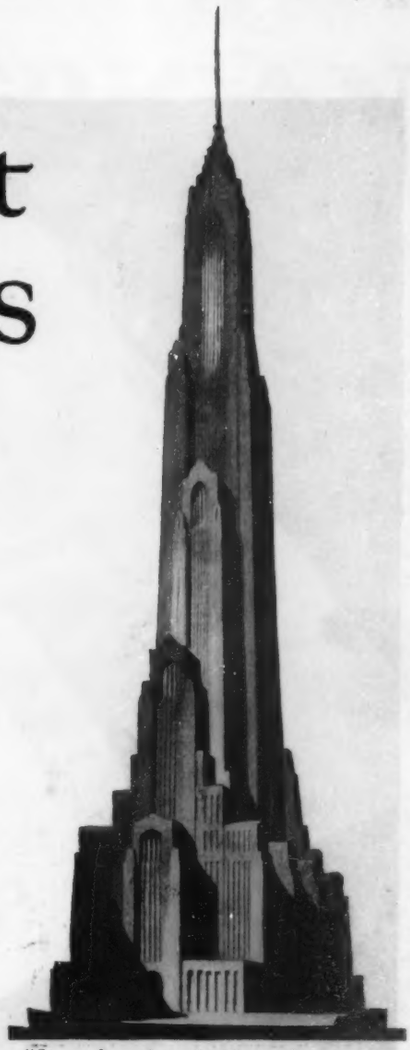
The man across the table will laugh.

"That's just what they said back in 1927," he will answer. "Remember? People were looking ahead apprehensively—and see what happened! Since then there has been the greatest growth in our history—more business done, more fortunes made, than ever before. They've certainly been good years for *me* . . ."

He will lean back in his chair with the easy confidence and poise that are the hallmark of real prosperity.

The older man will sit quiet a moment and then in a tone of infinite pathos:

"I wish I had those ten years back," he will say.



"Since then there has been the greatest growth in our history—more business done, more fortunes made, than ever before."

TODAY the interview quoted above is purely imaginary. But be assured of this—it will come true. Right now, at this very hour, the business men of the United States and Canada are dividing themselves into two groups, represented by the two individuals whose words are quoted. A few years from now there will be ten thousand such luncheons and one of the men will say:

"I have got what I wanted."

And the other will answer:

"I wish I had those years back."

In which class are you putting yourself? The real difference between the two classes is this—one class of men hope vaguely to be independent *some-time;* the other class have convinced themselves that they can do it within the next few years. Do you believe this? Do you care enough about independence to give us a chance to prove it? Will you invest one single evening in reading a book that has put 300,000 men on the road to more rapid progress?

This book costs you nothing—and for a good reason. It is worth only what you make it worth. It explains how for more than eighteen years it has been the privilege of the Alexander Hamilton Institute to help men shorten the path to success; to increase their earning power; to make them masters of the larger opportunities in business.

"FORGING AHEAD IN BUSINESS" is a cheerful, helpful book. It is yours for the asking. Send for it. Measure yourself by it. Look clearly, for a few moments, into *your* next few years. Whether or not you will follow the path it points is a matter that you alone must decide.

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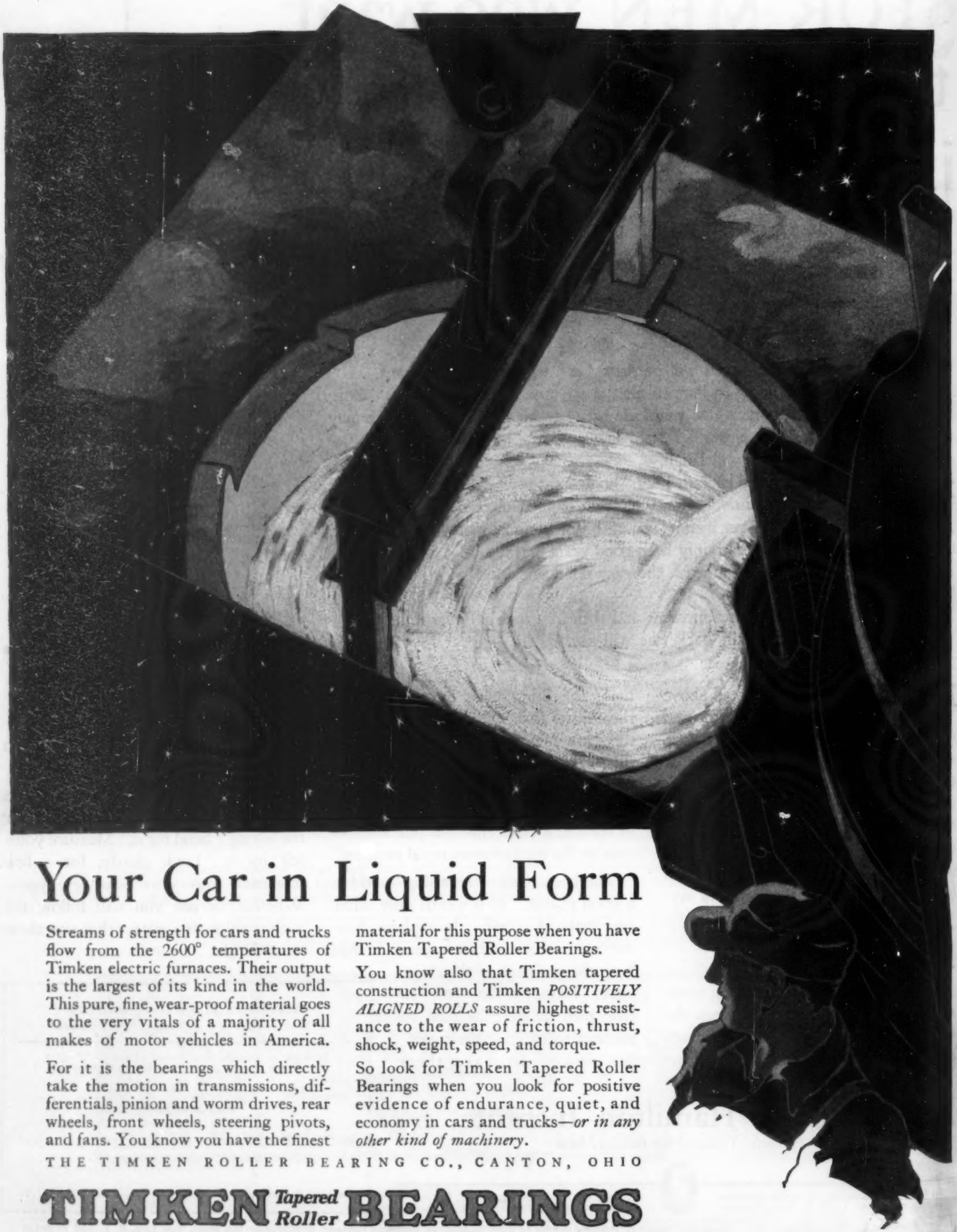

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Twenty Million Dozen Eggs

hauled last year by these International Trucks

Read this letter from Washcoegg:

International Harvester Company

Gentlemen:

In line with our own quality product, which we have every reason to be proud of, we want to give you credit for the part International Trucks are contributing to the success of our organization.

From a point of service Internationals are entirely satisfactory. Our oldest truck is still rolling and the cost of repairs is very negligible.

The International Truck is a high class product and International Service is second to none.

Yours co-operatively,

WASH. CO-OP.
EGG & POULTRY ASSN.

FROM the hen ranches around Seattle to the breakfast tables of New York is a long jump, but the big, white eggs of "Washcoegg" make it regularly. Washcoegg means Washington Co-operative Egg & Poultry Association—and that stands for 6,000 egg producers of the State of Washington.

Last year the hens of Washcoegg laid to the tune of millions of dollars. The Association hauled and shipped twenty million dozen eggs, more than half of the pack going to the Atlantic Seaboard, and great shipments to Alaska, Hawaii, South America and Europe.

Transportation is a vital factor when eggs are handled on this gigantic scale, and Washcoegg prefers International Trucks to all others. They standardize on Internationals! Their high praise of International performance comes out of years of heavy-duty truck service. Year in, year out, the great International Fleet of Washcoegg ranges up and down the hills and valleys of Washington, taking out tons of feed and supplies, bringing back tons of eggs—loaded both ways, always on the job.

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The International line includes the Special Delivery, Speed Trucks of 1¼-ton and 1½-ton sizes, Heavy-Duty Trucks ranging from 1½-ton to 5-ton sizes, Motor Coaches, and the McCormick-Deering Industrial Tractor. Served by 125 Company-owned branches in the United States and 17 in Canada—the farther you go from one the nearer you get to another. Write for complete descriptive literature.

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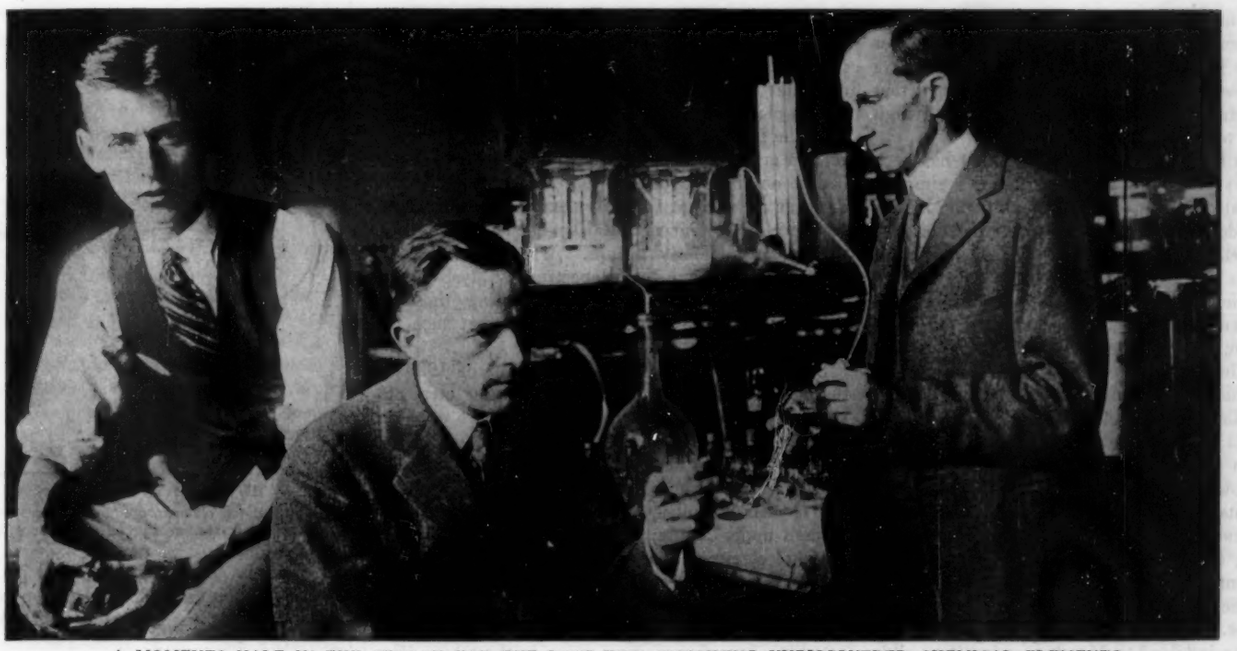
Wide World

Professor W. H. Keesom and the Apparatus with Which He Recently Attained the Lowest Temperature Ever Reached

"Helium solidified under a pressure of 150 atmospheres at the temperature of its boiling point, and under 28 atmospheres at 1.5 degrees, Absolute. Solid helium forms transparent mass,"—thus did Professor W. H. Keesom of the University of Leyden, Holland, recently announce to the scientific world that he had at last succeeded in freezing the gas, helium. At a temperature of seven degrees, Fahrenheit, above absolute zero (452 degrees below zero, Fahrenheit), a pressure of 2,175 pounds per square inch was required for solidifying the already liquid helium; at a temperature of about two degrees above absolute zero, a pressure of 400 pounds per square inch sufficed; while it would probably solidify at ordinary atmospheric pressure—about 14½ pounds per square inch—at a still lower temperature. Absolute zero has, however, never been reached. There is good reason to believe that, at this point the molecules of a gas would have no motion. It is thus the coldest that it is possible for any substance to reach. "In one experiment," said Professor Keesom, "part of the substance was liquid and part solid. One could hammer the solid block with the stirrer that was in the liquid part." For many years experiments with very low temperatures have been carried on at the University of Leyden

Curious Old Meridian Column for Determining Church Fêtes

In 1743 a meridian column was set up in the old Church of Saint Sulpice, Paris, for determining the date on which Easter and other church fêtes would fall. The column bears a long vertical mark extending down its center; this mark is prolonged on the floor, although it does not show in the illustration. Together, these two lines determine a vertical plane in space, which if sufficiently produced would include the earth's axis, and through which the sun would pass at noontime as the earth rotated. In order to make this event visible a small slit was cut through the roof of the church in the same meridian plane. Through it the sunlight penetrated, slanting downward toward the line below, and swept across it at noontime. As Easter approached, the sun's altitude in the heavens increased until the spot of sunlight finally crossed the line at the marked point. Since the other fêtes followed Easter by an arbitrary lapse of time, the old meridian column, installed by Maurice de Sully, determined them all.



A MOMENTS HALT IN THE SEARCH FOR THE LAST FEW REMAINING UNDISCOVERED CHEMICAL ELEMENTS

LEFT: *Dr. J. Allen Harris holds a small bottle containing some of the oxide of illinium.* CENTER: *Dr. L. F. Yntema with a small porcelain crucible containing a rare earth oxide.* RIGHT: *Dr. B. S. Hopkins with a solution of one of the rare earth fractions in a small flask. These men recently discovered element Number 61 and named it "illinium" in honor of the state of Illinois and its university, of whose faculty they are members*

Building Blocks of the Universe

The Romantic Search for New Chemical Elements Is Not a Blind Hunt But Is Guided By Remarkably Beautiful Scientific Principles of Prediction. How the New Element "Illinium" Was Found. Other Elements Are Now Being Sought

By B. S. Hopkins

Professor of Inorganic Chemistry, University of Illinois

NATURE builds up her most complex forms of matter out of simple units which are known as elements. Many of the things which we use most commonly in our daily life are elements in a simple form. Among these useful elements are the metals, such as iron, copper, lead, zinc, aluminum and silver. In addition, the elements carbon, sulfur, oxygen, phosphorus and chlorine are among our most useful everyday substances. By far the largest number of substances which we use, either directly or indirectly, in the course of the round of our daily habits, are compounds which are formed by the union of two or more elements.

Among the common and widely used compounds are water, salt, sugar, essentially all our foods, fabrics for our clothing, building material for our homes, all plant and animal tissue—in fact most of the objects about us. Some of these compounds are simple, as, for example, the ordinary table salt with which we season our food, which is composed of the two elements sodium and chlorine in an equal number of units or atoms. Water is composed of hydrogen and oxygen, there being twice as many atoms of the former as of the latter. Sugar is more complex; in fact to the chemist the name sugar refers to a large group of compounds, of which the most familiar is the usual table sweetening material called cane sugar or sucrose. Its simple unit, called a molecule, contains 12 atoms of carbon, 22 atoms of hydrogen and 11 atoms of oxygen. While this seems complex when compared with salt and water, it is really extremely simple when compared with many other compounds such as those used as dyes or as drugs.

While the number of compounds is enormous, the number of elements used to build up these compounds is definitely limited. Within the limits of our senses as they are now able to function, scientists are convinced that there are 92 elements possible. Students of the future may be able to extend the present bounds of knowledge into regions of whose existence we are entirely ignorant at present, but in the light of our present information, hydrogen is the lightest atom which can exist, and uranium is the heaviest. Within these limits science declares that there are 92 elements possible and no more.

Brilliant Physicist Killed in War

When the elements are arranged in the order of increasing atomic weight, it has been found that at regular intervals similar properties are repeated. By writing the abbreviations for the elements in such a manner that those with similar properties fall in the same vertical column, the entire list of elements is divided into a series of groups whose similar properties indicate clearly that they are fundamentally related. Because of the periodic recurrence of properties in this manner such a table is known as the Periodic Table. A simple form of the table is shown in Figure 1, which indicates the abbreviation or symbol of each element, the atomic weight in heavy type, and in lighter type the atomic number, which, it will be noted, indicates the position of each element in the series.

The method of determining the total number of building blocks which Mother Nature has used in the making up that part of the universe which we know, is interesting. It depends upon a principle discovered by the brilliant young British physicist, H. G. J. Moseley, just before the outbreak of the World War. When the war broke out Moseley enlisted, and his death during the disastrous campaign at Gallipoli was one of the severe scientific tragedies of the war. The discovery of Moseley involved a new use of the X-ray tube, one form of which is familiar because of its use by physicians and dentists.

An X-ray tube consists of a highly evacuated tube, so arranged that a powerful stream of electrons is shot off from the cathode and brought to a focus on a target as shown in Figure 2. From the target there radiates a system of X rays which consist of electromagnetic pulsations somewhat similar to the waves which produce the colors of the rainbow, except that the distance from the crest of one wave to that of the next, the wavelength, is vastly shorter. There are whole series of such waves, as shown by Figure 3, the effect produced depending upon the wavelength. The short wavelengths give us X rays; longer lengths produce waves similar to light except that they are not visible to the human eye. These are known as ultra-violet waves. They are known to affect a photographic plate markedly and they also have exceptional influence on health and nutrition. Beyond the ultra-violet we have the visible spectrum from the violet through the so-called primary colors to red, the longest waves which can be detected by the eye.

Scientific instruments are able to detect waves longer than the red, which are spoken of as belonging to the infra-red region. Far beyond these come the electromagnetic pulsations known as the radio waves. These waves may be very long, even as

much as 10 miles from one crest to another, although the usual length used in broadcasting is a quarter of a mile or less. So it is to be noticed that X rays are like these other forms of radiations, except that they are extremely short, powerful and with high penetrating power.

The contribution made by Moseley that has been of such great value in studying Nature's simplest forms of matter is that the wavelength of the X rays may be made to reveal the nature of the substance on the target. He found that when any particular element was placed on the target it gave rise to X rays which were characteristic of this element alone. When the elements were taken in the order of increasing atomic weight, each produced X rays whose wavelengths differed from those of its neighbors. If these lines are arranged uniformly with respect to some known reference line, then succeeding elements show a gradual and uniform shift in the position of their characteristic lines. Such a series is shown in Figure 4, with the lines of adjacent elements forming a well-defined stairway. If all the elements were included in this plan, there would be a continuous stairway with one step for every element.

Not all the possible 92 elements are known at the present time. The scheme of X-ray analysis, for which we are indebted to Moseley, makes it possible for us to tell exactly where in our series of elements there is one member missing. Thus, it will be observed at the top of Figure 4 that there appears to be a double shift as we pass from the element titanium, whose abbreviation is Ti, to the element calcium, represented by Ca, leaving one step missing in the stairway. In this case the element omitted in the figure is known, it being the rare element scandium. But in case there is a double shift at some point where no element is known, then it seems reasonable to suppose that there is somewhere on earth an undiscovered element which fits into this so far unoccupied space.

In every case where X-ray spectrum analysis indicates that there should be an unknown element, it is found that the Periodic Table makes necessary a similar conclusion. At these points, if succeeding known elements are placed together in regular position, the later members fail to fall into such closely related groups. But, if at such places a blank space is left on the supposition that someone later may discover an element for this place, then the regular sequence is continued and like elements fall into their regular family groups. Whenever both the Periodic Table and X-ray spectrum analysis agree in indicating that an element is missing, there is little doubt in the minds of scientists that such an element must exist.

Studies of this kind led the scientists of 1923 to the conclusion that there were five missing elements within the known limits of our table. Two of these unknown elements, Numbers 43 and 75, were considered similar to manganese, Mn, because they were placed directly under this element. The third missing element, Number 85, fell in the same vertical column under iodine; another is Number 87 under the rare element caesium, and the last, Number 61, belonged to that peculiar group known as the rare earths. This is a group of 15 elements of such similar properties that they are most conveniently indicated as occupying a single space in the table. The individual members of the Rare Earth group are shown at the lower part of the table. Element Number 61, the fifth member of this group, was counted among the missing elements until recently.

We have no idea when or where the first chemical element was discovered. It is certain that primitive man began early to use such of the chemical elements as were available, although of course there was at that time no distinction made between elements and compounds.

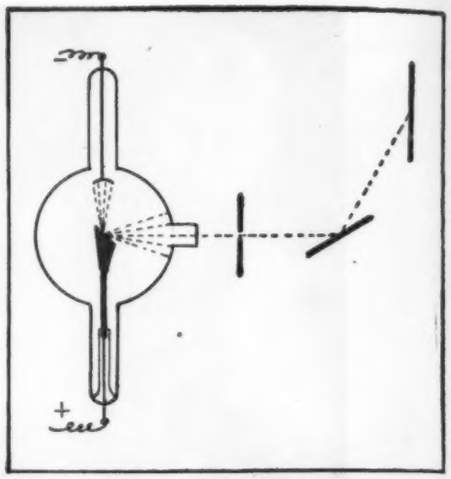
The first recorded discovery of chemical elements was made in 1450 by Basil Valentine, a noted German alchemist, who found the elements antimony

Group	0	I	II	III	IV	V	VI	VII	VIII		
Type Formula		R_2O	RO	R_2O_3	RO_2 H_4R	R_2O_5 H_3R	RO_3 H_2R	R_2O_7 HR			
Series 1		H 1 1.008									
2	He 2 4.00	Li 3 6.94	Be 4 9.1	B 5 10.85	C 6 12.005	N 7 14.008	O 8 16	F 9 19.0			
3	Ne 10 20.2	Na 11 23.00	Mg 12 24.32	Al 13 26.97	Si 14 28.1	P 15 31.04	S 16 32.06	Cl 17 35.46			
4	A 18 39.9	K 19 39.10	Ca 20 40.07	Sc 21 45.1	Ti 22 48.1	V 23 51.0	Cr 24 52.0	Mn 25 54.93	Fe 26 55.84	Co 27 58.97	Ni 28 58.68
4a		Cu 29 63.57	Zn 30 66.37	Ga 31 70.1	Ge 32 72.5	As 33 74.96	Se 34 79.2	Br 35 79.92			
5	Kr 36 82.92	Rb 37 85.45	Sr 38 87.63	Y 39 89	Zr 40 90.6	Cb 41 93.1	Mo 42 96.0	Ma 43 ?	Ru 44 101.7	Rh 45 102.9	Pd 46 106.7
5a		Ag 47 107.88	Cd 48 112.40	In 49 114.8	Sn 50 118.7	Sb 51 121.8	Te 52 127.5	I 53 126.92			
6	Xe 54 130.2	Cs 55 132.81	Ba 56 137.37	RARE EARTHS 57-71	Ct-Hf 72 178.6	Ta 73 181.5	W 74 184.0	Re 75 ?	Os 76 190.9	Ir 77 193.1	Pt 78 195.2
6a		Au 79 197.2	Hg 80 200.6	Tl 81 204.0	Pb 82 207.2	Bi 83 209.0	Po 84 210	85			
7	Rn 86 222	87	Ra 88 226	Ac 89	Th 90 232.12	Pa 91	U 92 238.2				

	RARE EARTHS	La 57 139.0	Ce 58 140.25	Pr 59 140.9	Nd 60 144.3	Il 61 146 ?	Sm 62 150.4	Eu 63 152.0		
		Gd 64 157.3	Tb 65 159.2	Dy 66 162.5	Ho 67 163.5	Er 68 167.7	Tm 69 168.5	Yb 70 173.5	Lu 71 175.0	

THE NEARLY COMPLETED PERIODIC TABLE OF THE ELEMENTS, 1926

FIGURE 1: *The possibility of arranging the elements in a beautifully interrelated system greatly facilitates research*



HOW X RAYS AID THE SEARCH

FIGURE 2: *Each element produces X rays having a wavelength that is specifically characteristic of that element*

and bismuth. Zinc was discovered in 1520, arsenic in 1699, cobalt in 1733 and phosphorus in 1738. Then discoveries came more rapidly. Many of these discoveries were made simultaneously in different countries, and some are still in dispute, so it is impossible to credit a definite number to each nation, but it is sufficiently accurate to say that 25 of the elements known in 1923 have been discovered in England, while Germany and Sweden may each be credited with 17, France with 14, Austria with 3, and Switzerland, Russia and Spain with one each.

The search for new elements has always been a fascinating task. In the early days the search was largely a blind one, discoveries frequently being made by mere chance. As the number of undiscovered elements grew less the search became more difficult, but as knowledge increased, the efforts of the searchers were directed by the predictions based on theory and experience. When it was recognized that the number of undiscovered elements was decidedly limited, the search became more exciting as chemists approached the point where they believed there would be no more elements to be discovered.

Following a "Warm" Trail

Armed with apparatus for measuring accurately the X-ray spectrum analysis, and guided by theories derived from the Periodic Table and recent knowledge concerning atomic structure, the modern search for missing elements leaves little to chance. Moseley's X-ray methods indicate what elements are missing, the Periodic Table shows what properties and what relationships the unknown element must have, and this in turn indicates in what native environment the unknown must be hiding. So the discovery of a new element becomes the supreme test for certain chemical theories and the accuracy of scientific reasoning.

Many of the recently discovered elements have been located by just such methods. After the discovery of argon and terrestrial helium, it became evident that there should be other inert gases in the atmosphere, one light in weight between helium and argon, and at least two heavier gases, all of which should be chemically inert. Sir William Ramsey in England secured a large quantity of liquid air, and from it he separated for the first time the light gas neon, and the heavier ones, xenon and krypton.

In 1911 Professor Urbain in Paris separated from some rare earth material a substance which showed new properties and apparently contained a new element. On account of the war there was a delay in applying the methods of X-ray analysis, but in 1922 this was done and the result seemed to indicate that a new element, Number 72 had definitely been

located. The name celtium was applied to the element, which was regarded as a member of the Rare Earth group because of its origin.

From purely scientific reasons Professor Bohr in Copenhagen reasoned that element Number 72 could not be a member of the Rare Earth group but must belong in Group IV, which would indicate its very close relationship to zirconium. Accordingly he suggested to his countryman, Professor Hevesy, that he examine some zirconium ores for evidence of the presence of element Number 72. When this was done, unmistakable evidence of the presence of this element was found in the mineral zircon. The name hafnium was given to the element, on the assumption that Urbain was mistaken. Immediately a controversy arose, each claiming the right as discoverer to name the element. It is impossible at this time to decide the dispute finally, for it seems quite within the range of possibilities that both men found the element under different environments. Certain it is that both men did some exceptionally accurate and skilful scientific work in applying to their problem the best of our modern scientific theories.

Reasoning from the relationship shown in the Periodic Table, Professor Noddack and his associates at Berlin concluded that elements Numbers 43 and 75 ought to resemble manganese in some respects but they should differ from it in others; they should also be related to columbium and tantalum. Searching in material containing these known elements, there was separated a small quantity of a substance which gave X-ray lines of the correct wavelength for these elements. Accordingly, early in 1925 announcement was made of the discovery of these two elements which were named masurium and rhenium, respectively. The existence of the latter in ordinary salts and ores of manganese has been shown by Druce and Loring in London, and by Heyrovsky in Prague. Recent work at the Platinum Institute in Russia has failed to confirm these results and so these two elements must still be considered doubtful.

The most recently discovered element is the one announced by the University of Illinois in March, 1926. This is element Number 61, the missing member of the Rare Earth group, to which the name "illinium" has been given in honor of the state and the university in which the work was done. The actual search for the element occupied about five years' time, the problem being extremely difficult because of the exceedingly complicated mixtures in which these rare earth elements are found.

In the manufacture of mantles for use on our gas jets, large quantities of the mineral known as monazite are imported annually from India and Brazil. This mineral is very complex, the most valuable component being thoria, which comprises from 4 to 10 percent of the ore. Thoria mixed with a little ceria is the material used in the gas mantles. There is very little use in normal times for the rest of the monazite after the materials for the manufacture of gas mantles is removed, so usually this residue is thrown away. It consists of a very complicated mixture of the salts of the rare earths. Prominent among these are the elements neodymium, Number 60, and samarium, Number 62. Our theories lead us to the conclusion that between these two elements there should be another, Number 61. The fact that unsuccessful search had been made for this element in several of the world's best laboratories may indicate that it is probably one of the most rare of the Rare Earth group.

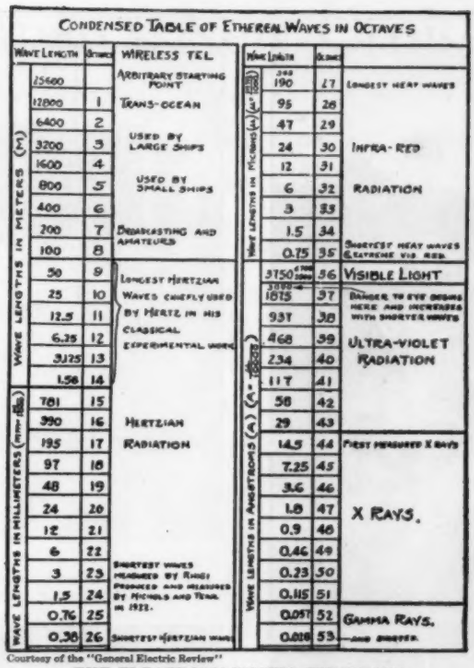
The most common method of separating the members of the Rare Earth group from each other is known as fractional crystallization. This is based on the fact that the salts of these elements differ among themselves in their solubility in a solvent such as water. The process is carried out by preparing a saturated solution at an elevated temperature and then allowing it to cool. Usually this causes a part of the salts in solution to crystallize out, and it is natural to expect that those salts which are least soluble will crystallize first. When this process is repeated many hundreds of times the less soluble salts are partially separated from those that are more readily soluble. Such work requires long, patient effort and it is obvious that the separations obtained by such methods can never be definite and sharp.

The usual process of fractional crystallization which is used for separating elements near neodymium and samarium, is the double magnesium nitrate which separates these elements in the order of their atomic numbers. This brings the element illinium between neodymium and samarium, both of which are relatively abundant and have a persistent habit of obscuring other closely related elements. Consequently it is particularly difficult to detect the scarce element illinium when it is surrounded by neodymium and samarium. It is quite probable that this explains why the element escaped detection for so many years.

When fractional crystallization is carried out with the use of the bromates, the order of crystallization is changed materially. Neodymium goes into the more soluble fractions while the elements terbium and gadolinium separate illinium from neodymium and samarium. Neither terbium nor gadolinium are troublesome about obscuring the presence of other elements which may be present in their solutions. As a consequence, the detection of illinium is more easily made in bromate solutions than in the double magnesium nitrate solutions. But the final proof of the existence of the new element, must of course be made with the X-ray spectrum. This work has been done with the location of two lines which are believed to be produced by atoms of illinium.

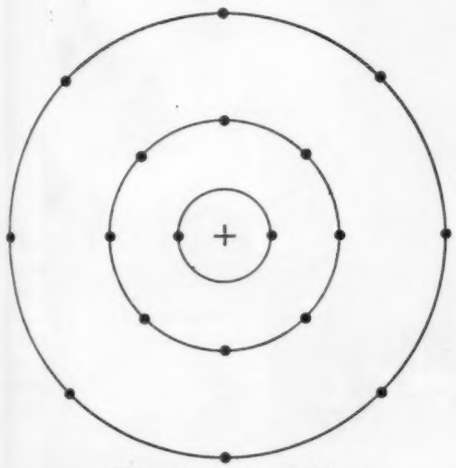
If further investigation confirms the conclusions drawn from the evidence already obtained, then we know 90 of the possible 92 elements. Search is being made for the two missing elements, Numbers 85 and 87, and the announcement of their discovery may be expected at any time. It is quite possible that unusual difficulties may be encountered in the search for these elements since it seems quite probable that they are radioactive elements which may be subject to very rapid decay. We must await further study along this line, which is fascinating but difficult.

When these two stragglers are added to our list of known elements then our table of Nature's building blocks will become complete.


CONDENSED TABLE OF ETHEREAL WAVES IN OCTAVES
WIRELESS TEL.
Arbitrary starting point
Trans-ocean
Used by large ships
Used by small ships
Broadcasting and amateurs
Longest Hertzian waves chiefly used by Hertz in his classical experimental work
Hertzian radiation
Shortest waves measured by Rubens produced and measured by Nichols and Tear in 1922.
Shortest Hertzian wave
Longest heat waves
Infra-red
Radiation
Shortest heat waves & extreme vio. red
Visible Light
Ultra-violet radiation
First measured X rays
X Rays.
Gamma Rays.
Courtesy of the "General Electric Review"

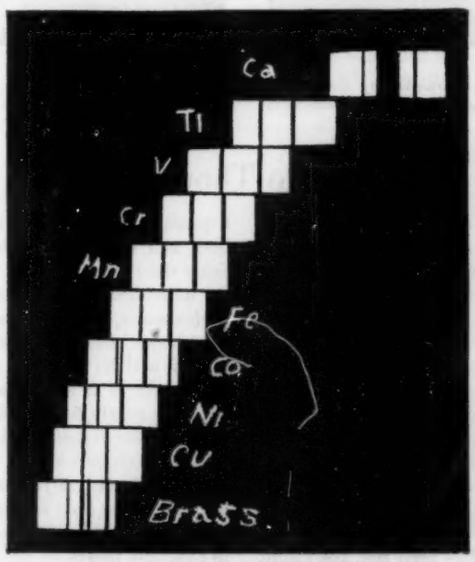
THE ELECTROMAGNETIC SPECTRUM

FIGURE 3: *Hertzian waves, heat and light waves, X rays and gamma rays are all of a kind, differing only in wavelength*



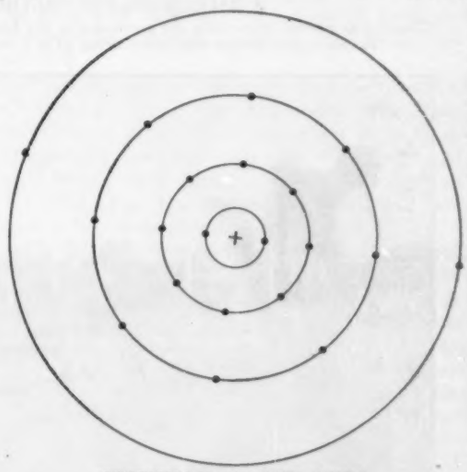
ELEMENT No. 18, ARGON

FIGURE 5: *It has eighteen electrons and is chemically inert*



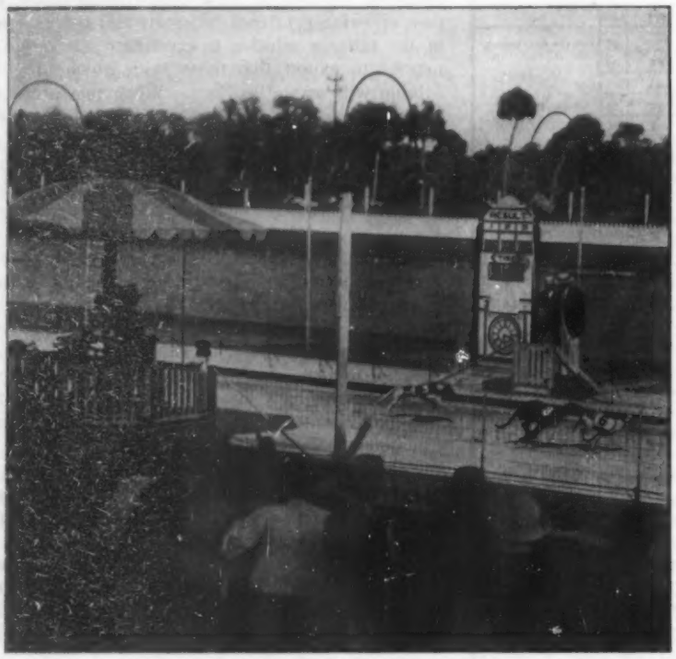
MOSELEY'S X-RAY SPECTRA

FIGURE 4: *Using the X-ray tube (see Figure 2) Moseley found that the spectral lines show a systematic shift*



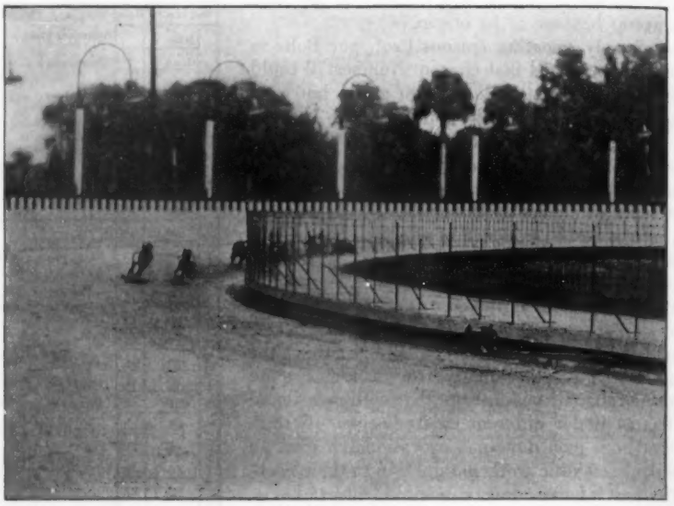
ELEMENT No. 19, POTASSIUM

FIGURE 6: *Its added electron makes it chemically active*



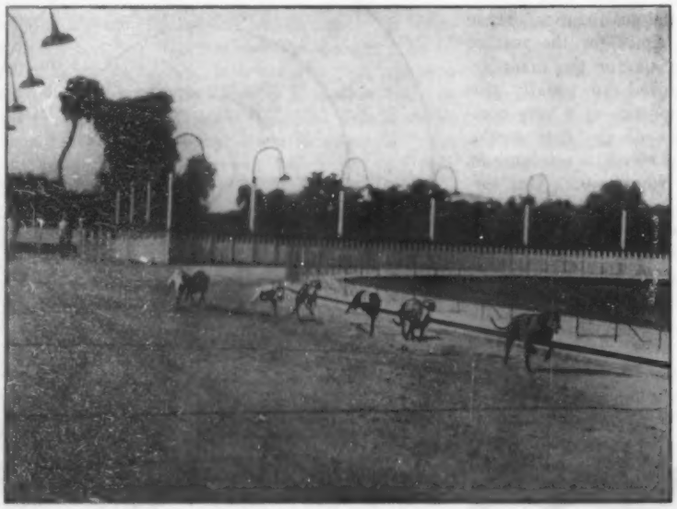
A RACECOURSE FOR GREYHOUNDS

Contrary to general impression, the greyhound is the fastest animal that runs, except the horse, the comparative times being 25⅘ seconds and 21¼ seconds



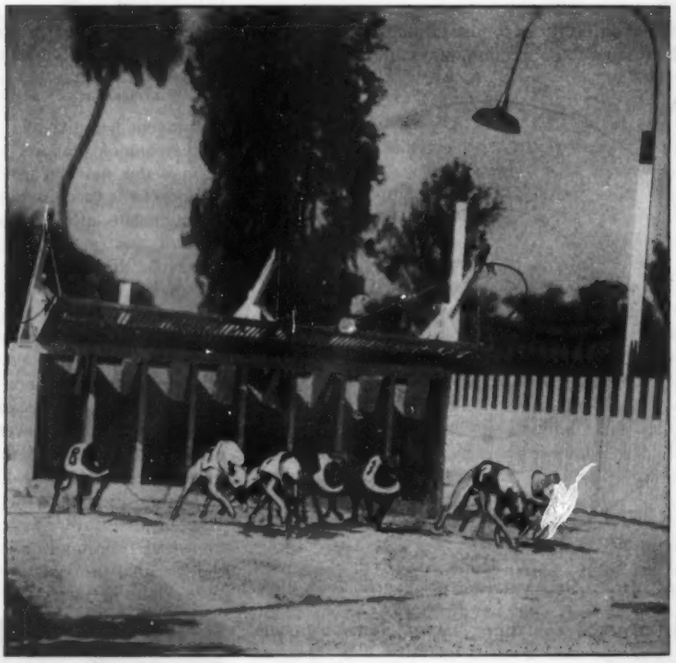
IN FULL CRY

The mechanical rabbit is a stuffed skin carried on a six-foot arm by a miniature four-wheel electric truck inside the rail, which keeps ahead of the hounds



DOWN THE STRETCH

A running greyhound is guided by sight only and down the straightaway the fastest dog will take the rail at the turn. Thus crowding is practically eliminated



THEY'RE OFF!

When the barrier is sprung, the dogs immediately see the mechanical rabbit about 40 feet ahead. They chase it around the course until it disappears into a trap

A Sport Over Two Thousand Years Old

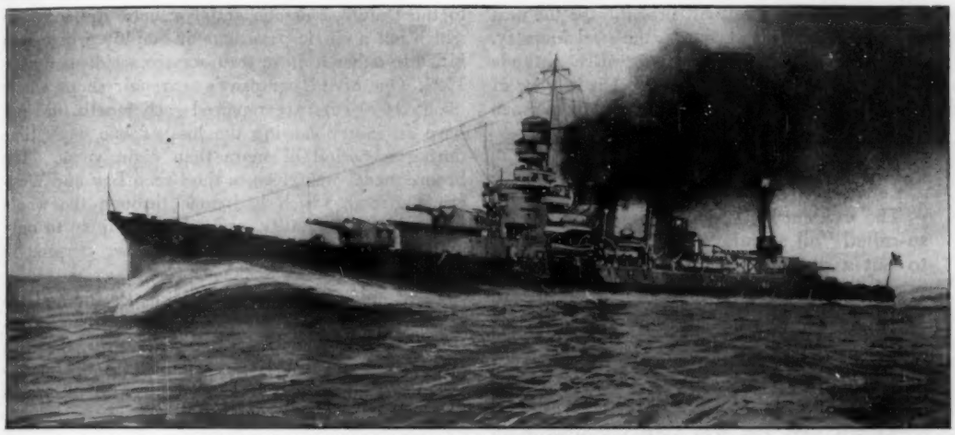
One of the oldest of all sports is coursing. Arrian, A.D. 150, wrote a long and elaborate treatise describing what in all essentials was the sport as it is today. Yet before this we find inscribed on ancient ruins, not only the hound of the chase, but what without question is the forerunner of one of England's oldest sports, dating back to Elizabethan times, the revival of which is now spreading picturesque race courses throughout this country. A mechanical rabbit has been developed as a means to urge the dogs to speed and to permit races in enclosures where greater numbers of spectators can be present than is possible in field trials. The first track of this kind was installed at Emoryville, California, in 1919. A miniature electric railway carrying a mechanical rabbit on the end of an arm runs in a boxed enclosure. Power is supplied by a third rail. The operator, located in a tower from which all points of the track can readily be seen, manipulates an electric controller so that the rabbit is kept at just the right distance ahead of the coursers. After the distance has been run, the rabbit disappears into the enclosure through a special opening. This is done by tripping a lever on the electric carriage which swings the carrying arm back and draws the rabbit in behind the carriage. The attendants then catch the contestants and return them to their kennels. The top speed of an individual can be attained only every other day with regularity of performance, provided the proper racing weight is held for each animal. This being maintained and the same dogs being raced time after time, the winner will be the same dog four times out of five. Sixty-five pounds is the weight of a good sized specimen, but the average racing weight will be more nearly 56 pounds. However, size has little to do with speed, as some of the record holders have been very small. The distance run is usually one-quarter of a mile, although some races are held at five-sixteenths, this course requiring no more of a dog than he would expend if allowed to be free to play. Longer distances are not attempted because the dogs would be distressed and worn down, thereby losing their keenness to run. By means of proper training and regulated races with the mechanical rabbit leading, the racers are kept in prime condition.

Japan's New Cruisers

Latest Addition to the Growing Fleet of Cruisers Consists of Four Ships Showing Remarkable Novelty of Design

By Oscar Parkes

APART from the interest which we all feel in the development of the Japanese Navy, the most recent additions to the ever-growing cruiser fleet which is being built up on the other side of the Pacific will attract special attention on account of the novelty of their design and the number of fresh features which they incorporate. Without a doubt they are the most interesting cruisers in existence.



THE LATEST JAPANESE CRUISERS "KINUGASA" AND "AOBA"

The Kinugasa *and* Furutaka *classes are identical in hull dimensions, which are: length on waterline 580 feet; beam 50¾ feet; draft 14¾ feet. The* Kinugasa *and* Aoba *mount six 7.5-inch guns in three, two-gun turrets*

Built under the utmost secrecy, the four ships *Furutaka, Kako, Kinugasa* and *Aoba* have hitherto been regarded as belonging to one class, but the latest intelligence from Japan shows that the two latter ships carry their guns differently arranged. No reliable details of these designs have been obtainable until the present time and the following account is the first to reveal the real details of the two classes.

The displacement of the class is 7,100 tons, which brings the ships into the same general category as the American *Omaha*, the British *Emerald* and *Enterprise*, the French *Duguay Trouin*, the Spanish *Cervera* and the Dutch *Java* types. But whereas all these carry guns of from 5.9 inch to 6.1 inch, the Japanese ships mount a 7.5-inch piece which fires a projectile of approximately double the weight of the smaller guns. In official naval returns they are credited with eight-inch guns, but on their displacement, they would be greatly overgunned with such a caliber.

In the *Furutaka* and *Kako*, six guns are carried in six single-gun houses, mounted in groups of three fore and aft. These gun houses are made of light armor and have an entrance door and two ports at each side. The second and fifth guns are raised to a considerably higher level than is usual in the case of super-firing guns, and have an extraordinarily high command.

It may be remarked that this unusual method of gun distribution was adopted with a view to isolating the firing positions as much as possible, so that a single shell cannot put more than one gun out of action. On the other hand, it adds very considerably to the weight and reduces the end-on fire to two guns, although in action no ship would deliberately steam dead astern to her opponent and risk being mined. All six guns can be brought to bear on a mark a few degrees off the axial line and should be capable of a high rate of fire.

The anti-aircraft armament of four three-inch guns is carried amidships athwart the funnels, two on either side. A catapult is carried on top of number four turret and another is on the deck forward and beneath it. A long derrick on the main tripod mast can be used to lift planes onto the catapults and also to hoist them aboard. Abaft the second funnel is a somewhat complicated structure formed by the hangar, surmounted by a control station and flanked by range-finders. It is understood that planes can be run out from the hangar onto the deck catapult. These are the first cruisers to be fitted in this way.

A heavy torpedo armament is mounted, there being six tubes in pairs on each side. The foremost ones are just under the gap between number three turret and the superstructure, while the second and third are fitted between the second funnel and mast, all being on the main deck. It has been reported that all twelve tubes can be brought to bear on either beam, but this is not so.

The hull is unique and merits special attention. Although nominally "flush-deckers," the topside proceeds aft in a series of gentle undulations, there being a steep sheer at the bows, a rise above the first pair of torpedo tubes and again amidships with a slope aft from the fourth turret to the stern. Under the forecastle the side is well flared, but from the superstructure it takes on a wedge-shaped tumblehome as far as the after raised turret. Both the main and lower decks are apparently armored along the greater portion of this area. The dimensions are: length 580 feet (water line), beam 50¾ feet and draft 14¾ feet. The bow is markedly raised.

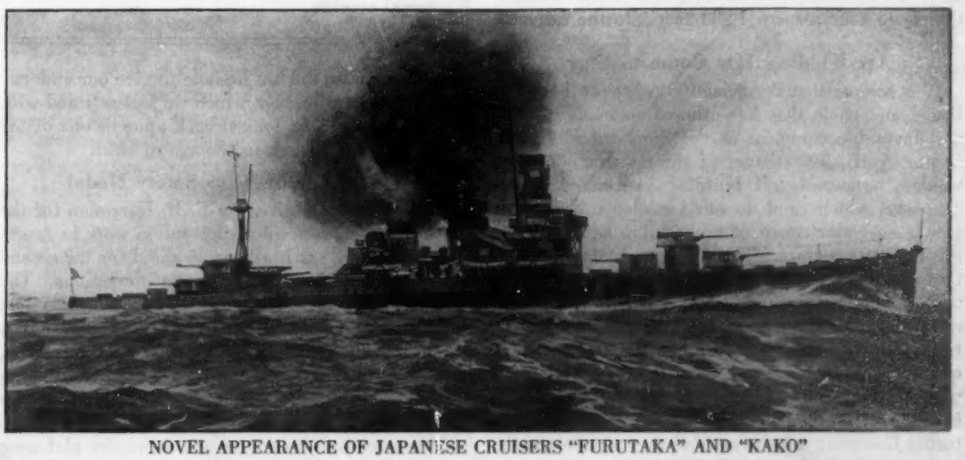
A noticeable feature is the big superstructure forward containing the sea cabins, searchlight control, and navigating positions, with range-finders on light wing-bridges. The mast is of a novel pattern, being cone-shaped and surmounted by large spotting and control tops, and should be very stiff and free from vibration.

Geared turbines of a nominal horsepower of 100,000 are designed to give a speed of 33 knots, but this figure has been greatly exceeded on trial. No reliable information as to the exact speed reached is obtainable, but current gossip at Kobe credited the *Kako* with something well above 35 knots, and judging from photos of her on trials she seems capable of it.

There are twelve Kampon boilers, mixed coal and oil burning, with uptakes leading into three stacks, the foremost of which is trunked aft clear of the bridges and mast and paired up with the second, both having their greatest diameter athwartships. The third funnel is stepped normally and is slightly shorter than those forward.

The *Furutaka* was built at the Mitsu Bishi yard, Nagasaki, and the *Kako* at the Kawasaki yard, Kobe.

In the second pair of ships the arrangement of the guns has been modified, and in the *Kinugasa* and *Aoba* they are paired in turrets instead of being mounted singly. Two of these are situated forward and one aft, giving an ahead fire of four guns, astern of two and broadside of six. Thus a better concentration forward is achieved at the expense of greater vulnerability as two guns will be put out of action if any turret is damaged. Excepting for this, these two ships otherwise resemble the *Kako* in general details. It is understood that the two catapults will be carried between the second funnel and main mast, the aft one being raised on a platform. These two ships are still completing for sea and should be ready for trials shortly.



NOVEL APPEARANCE OF JAPANESE CRUISERS "FURUTAKA" AND "KAKO"

The Furutaka *mounts six 7.5 inch guns in six one-gun turrrets, placed three forward and three aft. Displacement of the* Furutaka *and* Kinugasa *and sister ships is 7,100 tons. The* Kako's *contract speed of 33 knots was exceeded*

Our Point of View

Foresight and Hindsight

IF we city builders of today were as skilful in foresight as we are facile in "hindsight," many of the material blunders and worriments of our "complex civilization" would never have descended upon us. Broadly, in saying this, we have in mind the modern, great city, to live and move in which is becoming something of a nightmare. Specifically, we are thinking of the skyscraper, some half dozen of which, thirty-plus stories in height, are growing up, mushroom-like, around our own modest 16-story home.

When the skyscraper period began and those majestic towers—for towers they were—lifted their proud heads high above the rooftops of their humbler neighbors, the world gazed on them with shouts of approval. "Stupendous! Enormous! Magnificent! A whole city-full on a single block!" Then, after a while, Mr. Hindsight, as he went to and from his daily task through certain gloomy "city canyons," as he began to call them, realized that in applauding the skyscraper, he had forgotten certain penalties of discomfort which were sure to follow their multiplication. He began to think about such matters as "light and air," and after much misgiving and in spite of furious opposition from vested interests (realtor, architect, builder, et cetera) he succeeded in getting on the statute books a law which demanded that, when a building reached a certain height, its facade should be stepped back so as to allow the light to fall upon the buildings opposite and upon the street below.

So far, so good; but Mr. Hindsight had scarcely got through the pleasure of shaking hands with himself on this accomplishment, when he discovered that the city streets were becoming so jammed with people and vehicles that, in the busiest sections, traffic was faced with the possibility of an absolute dead-lock. At this hour, Mr. Hindsight is asking his fellow citizens, "What in the world are we going to do about the tall building and the maddening and apparently endless problems which it has brought in its train?" The most radical course would be to prohibit the construction of these monstrosities altogether; but an equally effective and more sane plan would be to limit the number that can be built on a single block.

And the end is not yet. Detroit is putting up an office building over 800 feet high; and as this is written a leading paper shows a New York structure that is to soar a mere 1,200 feet into the heavens.

Arc-Welding Has Come to Stay

IT is seldom that the Scientific American has published an article that has aroused so much interest and favorable comment as the short account given in our April, 1926 issue, of the construction of a welded, structural-steel building in Canton, Ohio. The facts which came to our knowledge seemed to justify an endorsement of arc-welding as applied to this type of structure. There was one notable exception to the chorus of approval, in the case of a large western engineering firm, which assailed our modest endorsement and affirmed that the claimed advantages of the substitution of welding for riveting were exaggerated. Later in the year—November, 1926—we published an article by a member of the engineering staff of the Westinghouse Electric and Manufacturing Company which revealed that after extensive and very thorough tests, the Westinghouse Company was putting up a five-story, arc-welded structure.

This is rapid progress for a comparatively new art; and now it receives its final and most compelling endorsement in a statement by Charles M. Schwab, President of the American Society of Mechanical Engineers, that 17,500 dollars has been offered through the Society for the best papers on arc-welding submitted in a world-wide competition. Mr. Schwab, who, by virtue of his past experience must be considered, surely, as having a preeminently authoritative voice, when he speaks of steel, said, in making this announcement, that he considered that the replacement of cast iron and riveted steel with arc-welded structural steel will probably be the next great step forward to be taken by the steel industry. Caution and a reasonably conservative attitude should mark all editorial utterances; but in view of the results achieved and of the character of the men behind them, we did not hesitate to give our endorsement to an improvement which we feel satisfied will, in years to come, be looked back upon as one of the outstanding milestones in the age of steel.

That Japanese Bogey

The evidence given under oath in the so-called "oil scandal" case should serve to put a quietus upon the anti-Japanese propaganda, at least so far as it concerns the danger of an attack upon our coasts by the Japanese fleet. Among the many ill-considered and injurious accusations against Japan, none, in our opinion, has been more unjust and absurd than the statement that she was contemplating a descent upon our coasts. The leading statesmen of Japan are too wise, too well-balanced, ever to sanction such a preposterous venture, and her naval men have learned too well the lessons of the World War to despatch their fleet 6,000 or 7,000 miles from its base to wage war on the most resourceful and wealthy nation of modern times. The war confirmed the belief among naval strategists that no modern fleet should venture to attack an enemy coast or an enemy fleet situated several thousand miles from the attacking fleet's home waters. The absence of a nearby base of supplies and nearby dockyards for repairs, to say nothing of the difficulty of protecting lines of communication several thousand miles in length, would render an attack on our coasts by the Japanese fleet an act of deliberate naval suicide.

Union Pacific Wins Safety Medal

THE gold medal given by E. H. Harriman for the most conspicuous accident prevention work in America during the year has been awarded for the second consecutive year to the Union Pacific System. The award was based on the records of the Interstate Commerce Commission, which showed that not a single passenger was killed in 1925 on this system, though it operated more than a billion passenger-miles. Furthermore, only five employees were killed in non-train accidents.

This very fine record results from the elaborate safety-first methods adopted by the company and the enthusiastic manner in which everyone, from president to the humblest employee, has cooperated to make railroading a safe occupation. The statistics show that the casualties have been reduced from 1,620 in 1921 to 664 in 1925.

In announcing the awards, Arthur Williams, President of the American Museum of Safety, stated that the statistics examined by the Committee of Awards showed a remarkable record of accident prevention on practically all of the railroads of America. The silver replica of the Harriman Medal for the best safety work among roads operating between one million and ten million locomotive miles was awarded to the Duluth, Missabe and Northern Railroad, on which not a single passenger or employee had been killed in either train or train-service accidents during 1925. One of this company's car repair shops, where about 2,000 cars are repaired each month, did not have an injury causing the loss of one day's time during a period of more than eight years. The bronze medal was given to the Green Bay and Western Railroad, which had gone through the whole year without a fatality, and with an injury to only one employee and to only four other persons in train or train-service accidents.

Great credit is due to the Union Pacific and the other railroads for these fine humanitarian accomplishments. It should be noted, however, that this steady improvement is not confined to the medal-winning companies but is characteristic of practically all the American railroads.

Our Naval Policy

THE Navy Department has recently laid down a set of definitely enunciated policies which can be followed by all concerned. The task of developing this policy was assigned to the General Board, which is composed of the ablest and highest-ranking officers of the Navy. As a fundamental naval policy, the following was adopted:

"The Navy of the United States should be maintained in sufficient strength to support its policies and its commerce and to guard its overseas and continental possessions." Because of our acceptance of the treaty for the limitation of naval armament, it became necessary to adopt a general policy as to strength which would conform to that agreement. Although the ratios adopted by the Conference applied only to capital ships and plane carriers, the Navy Department considered that it was the intention of the other nations that were party to the agreement, that the ratio of 5-5-3 should apply to the relative total strengths of the navies concerned. Hence, it adopted the following general navy policy: "To create, maintain and operate a navy second to none and in conformity with the ratio for capital ships, established by the treaty for the elimination of naval armament."

It is to be regretted greatly that the decisions of the Naval Conference did not cover all classes of ships; for that omission left the various navies free from legal, if not from moral, restrictions against exceeding the 5-5-3 ratios as applied to cruisers and smaller craft. This has prejudiced the standing of the United States; for whereas we are building only two of the treaty 10,000-ton cruiser type, other nations have from eight to ten such ships under construction. The Scientific American has always asserted, and still believes, that in capital ships the United States is maintaining parity with the British fleet. But in cruisers she is not. Hence, Congress should vote the funds for the three additional 10,000-ton treaty cruisers requested by the Navy.

Science Plans a Mass Attack on the Moon's Mysteries

Are the Moon's Craters Volcanic or Are They Meteoric "Shell-holes"?

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University
Research Associate, Mt. Wilson Observatory of the Carnegie Institution

IT is very rarely, if ever, that a scientific problem is "worked out" and exhausted —there is always at least the chance that some new development of theory, or some additional refinement of observation, may open up a new and profitable line of exploration. But sometimes there are long periods of inactivity, when little work is done in a given field, even for decades, while attention is diverted to other more promising lines of research.

One of the most striking instances of this sort in the astronomical realm is afforded by the moon. With respect to some of the principal characteristics of our satellite, it is true, our knowledge appears to be substantially complete. Her size, distance, mass and density are known so well that future investigators can only have the joy of adding one more decimal place (if they are lucky, and work hard) to a figure already pretty closely known. Her motions in the heavens, although very complicated, have been worked out with great thoroughness and high precision, and little more apparently remains to do.

But we know little more of the surface details of the moon than our grandfathers did, if they, too, were astronomers. We can see finer details on the moon with the smallest telescope than we can hope to see on any other heavenly body with the greatest, and photography enables us to make accurate and complete records of all but the very smallest objects which we can see.

Moon Never Had an Atmosphere

Plains, mountains, craters, lines of cliffs, deep, narrow cracks—all these have been seen, named and catalogued for half a century—yet we know little more of their nature and origin now than people did then. We know that there is neither air nor water on the moon; that its surface has the reflecting power (on the average) of rather dullish rock; that the rapid fall of brightness from the full moon to the half and the crescent shows that the surface must be very rough, and covered with irregularities, some as big as mountains, some perhaps as small as pebbles, which, by their shadows, diminish the illumination except when we look right down the path of the sun's rays toward the full moon—and all this was known 60 years ago. Since then we have found out a little; we know now that the moon's gravitational attraction is insufficient to prevent its atmosphere from flying off, molecule by molecule, into space and we are therefore sure that it never has had an atmosphere, or water on its surface, since it became an independent body.

We have learned, too, more recently, how to obtain reliable measures of the temperature of the surface, and it has thus been found that, in the middle of the long lunar day, the temperature rises to about 250 degrees, Fahrenheit. During the two weeks' night, it must fall very low. The latest calculations, by the Austrian, Dietzius, indicate that, just before sunrise, it gets down to about 100 degrees below zero. This helps us to understand why the surface is so rough; exposed masses of rock, when subjected to such great changes of temperature, would surely tend to crack; masses of fragments would accumulate, and the interstices between these would form the shadow-filled holes which darken the surface when the moon is not near full.

But when we ask—how did the moon come to have its present rough and often chaotic surface?—we find ourselves much less able to answer than when faced with similar problems on the earth. Yet the lunar problems are really simpler. The earth's surface is continually being worked over by the action of rivers, the wind and the sea; mountains are worn down to plains, and their debris cast into the sea, perhaps to form the raw material for new mountain chains. But on the moon no such destructive forces are at work; the surface irregularities, once formed, must endure until they are buried or overwhelmed by new mountain-building actions.

It is no wonder, then, that in its rougher parts the moon's surface is a jumbled mass of craters, more rugged and irregular than anything on the earth. We understand, too, one of the most notable differences in the topography of the earth and the

Yerkes Observatory

THE MOON THROUGH A TELESCOPE

Trace the several white streaks that radiate from the crater Tycho at the top. What caused them?

moon; there are no valleys there, for valleys are carved out by running streams.

But what formed these innumerable craters? Were they produced by volcanic eruptions like those which we can observe on earth, or perhaps, as some have suggested, by the impact of gigantic meteors—as appears to have happened in Arizona so recently that wind and rain have not had time to wear down even the sides of the resulting crater? Why are the crater floors usually much below the level of the surrounding country? And why do some, and not others, have central mountains, rising high above the floor, but usually falling far short of the rim? Most puzzling of all—why are a few craters, such as Tycho and Copernicus, surrounded by whitish "rays"—nearly straight streaks which extend far over the moon's surface sometimes for hundreds of miles, running right over hill and dale—and why are these "rays" much more conspicuous near full moon than at other times?

We know that the lunar craters were not all produced at once, for in a number of instances one crater cuts into another, "biting off" a piece of its wall, in such a way as to make it obvious at a glance that it was formed later than its neighbor, and, in its formation, destroyed a portion of its rim.

The huge size of some of the craters, up to a hundred miles and more in diameter, presents another puzzle. Most puzzling of all, in many ways, are the large dark areas which form the conspicuous spots visible without a telescope, and called by Galileo the *maria* (Latin for seas). They are not seas, however, but great plains—almost as level as the sea, of much darker rock than the rest of the surface, and with but a few craters scattered here and there over their surfaces.

These questions are today unanswered; but they are probably not all unanswerable, provided that all available knowledge is brought to bear on their solution. For half a century the astronomers have usually taken the moon's surface details for granted without speculating much about it, and the geologists with a few exceptions have regarded them as outside their field of study.

It is generally believed now by geologists that the molten lava and high-pressure gases of a volcano originate in incandescent pockets far below the earth's surface, and such "magma chambers" might perfectly well have existed deep beneath the surface of the moon. If, as many believe, the volcanic heat comes from radio-activity in the rocks, this source would be available on the moon, and the molten matter might work out to the surface, in mighty eruptions.

Possible Reason for "Rays"

The geologist, in picturing such an eruption, has to be continually on his guard to remember how different some things would be on the atmosphereless moon. The force of gravity there is so small that the same ejective forces would throw rocks six times as far as on the earth (or even farther if the speed was high), and, in the absence of all air resistance, sand and dust would fly as far, and settle as fast, as great boulders.

The impact of a huge meteoric mass (perhaps a mile or more in diameter in extreme cases) would generate so much heat as to melt everything in the vicinity, and might easily send out splashes of the molten stuff at such speed that they flew for hundreds of miles before they came down. Such splashes may perhaps account for the remarkable straight "rays" which are evidently superficial features.

These are only a few of the suggestions which might be made. If the problem should be seriously studied in collaboration with geologists familiar with the details of terrestrial volcanos and the theories of their origin; by geophysicists, who have studied the properties of melted rocks and the behavior of solid rocks under great stresses; and by astronomers and physicists, who are familiar with the methods, results and limitations of our means of observation of the moon, and with the general properties of matter—in whatever way these apply to the case, our knowledge might be greatly extended in a few years.

Fortunately, plans for such a cooperative attack on the problem are at present being formed, under the auspices of the Carnegie Institution. How great the results will be, only the event can tell; but the attempt is very much worth while, and those who participate in the investigation are likely to have a very good time while they are about it.

Where Was the Birthplace of Mankind?

Flints Called Eoliths, 1,000,000 Years Old and Flaked so Crudely that Only the Expert Can Tell Whether Man or Nature Made Them, Have Been Discovered in Europe. What Do They Signify?

By J. Reid Moir

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

One of the most interesting pursuits is the systematic study of ancient man's workmanship in stone, for these studies throw direct light on the gradual evolution of his intelligence. Starting with the present time and delving deeper and deeper into antiquity we first pass the comparatively recent New Stone Age with its generally superb skill. Then the Old Stone Age is traversed, several hundred thousands of years in length and containing within itself a marked evolution in workmanship. But even before that, as we push back towards the dimmest horizons, we reach the stage where man's implements consisted simply of stones picked up because they were already fairly well shaped by nature for his purposes, and improved by his dawning intelligence. These are the eoliths and it is chiefly of them that Mr. Moir, discoverer of thousands of them, here writes so entertainingly. More than anyone else, Mr. Moir was instrumental in establishing that the eoliths were partly man-made instead of altogether accidental products, as was formerly claimed—and is still claimed by a few "die-hards." *The Editor.*

ALTHOUGH all those who have made a study of the matter are convinced that man has, during an immense period of time, been slowly evolved from a very primitive ape-like condition to his present high development, yet the exact part of the world where the earlier stages of this momentous process were gone through has not been definitely ascertained. The solution of this problem which, of course, in no way invalidates the truth of human evolution, is of great interest and importance to science and to everyone.

It may be said at the outset that there are in existence two opposing schools of thought upon this question—one favoring the idea that to Asia must be accorded the honor of being the birthplace of mankind, while the other regards western Europe as having had that distinction.

Now, it will be realized that in attempting to decide where man originated, the only facts that can carry real weight and influence a decision, are discoveries in ancient deposits of *actual remains of man*—either in the form of portions of his skeleton, or as undoubted works of his hands—such as stone implements. When the matter is looked at from this standpoint, there cannot be any doubt that so far as discoveries of prehistoric relics are concerned, Europe has, in every way, most in its favor. It is, however, necessary to recognize that this part of the world has been explored extensively by archeologists for many years past, whereas the investigation of Asia is only just beginning. But we must take the facts as we find them, and these demonstrate beyond question, that western Europe is infinitely richer in remains of early man than is Asia.

It has been pointed out by Professor Henry Fairfield Osborn that during the period of archeological research intervening between 1823 and 1925, the fossil bones of no less than 116 human beings—referable to the Old Stone Age, or even earlier—have been found in Europe, while the number of flint implements of different ages discovered in this area is literally beyond computation. These relics of remote humanity range from the earliest to the latest paleolithic times, but no one supposes that the first-made implements of this period represent man's initial attempts to shape stone by flaking, and so the presence of even the oldest paleolithic specimens in any given locality does not by any means prove conclusively that man originated there.

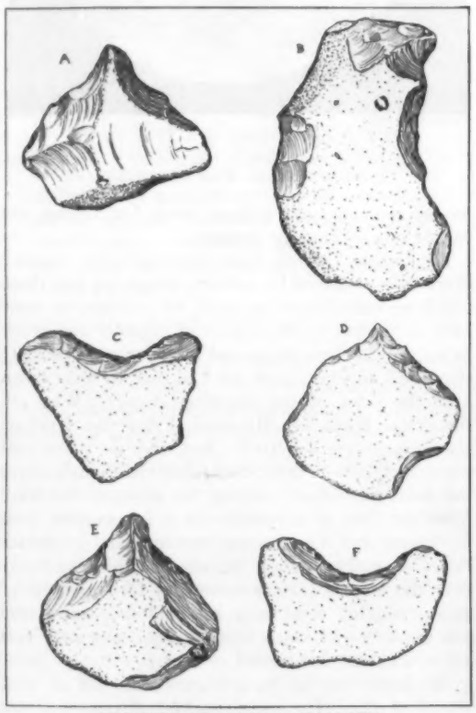
Fortunately, there has been found in southeastern England and in France evidence of the former existence of man at periods long pre-dating that of the earliest paleoliths, and it is to the earliest of these pre-paleolithic implements that I wish to draw particular attention. These specimens are made from pieces of flint naturally produced in tabular shape, and they exhibit steep flaking along one or another of their edges, which has caused the flints to assume various implemental forms.

I have made a very close study of these flaked flints and have carried out numerous experiments in flint fracture in order to see whether such specimens can be produced by natural, non-human means. These investigations have convinced me that the type of flaking exhibited by these eoliths, and their very definite types, again and again repeated, can only be accounted for by regarding these specimens as having been shaped by some intelligent being. Thus, some of the eolithic flints are pointed (Figures 1A, 1D and 1E) and could have been used for boring holes in various materials. Others represent *racloirs*, or side-scrapers for dressing skins and for cutting purposes (Figure 1B); while the hollow-scraper (Figures 1C and 1F) is a common type and would have been very useful in shaping wood and bone.

The eoliths, as they are called, are represented by only two or three types and their forms of flaking

J. REID MOIR

The editor requested an informal photograph of the author—note the pet fox terrier lying on his lap

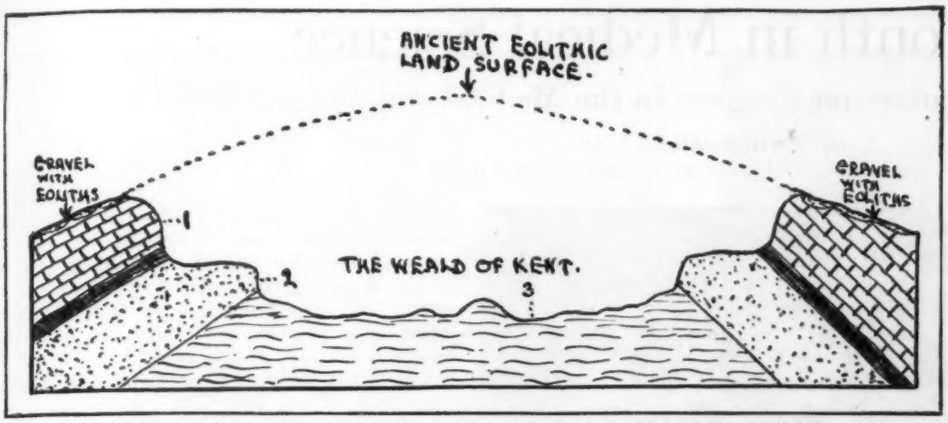


EOLITHS OF VAST ANTIQUITY

FIGURE 1: *These primitive implements were made by the first human beings, over 1,000,000 years ago, and found in England by the author*

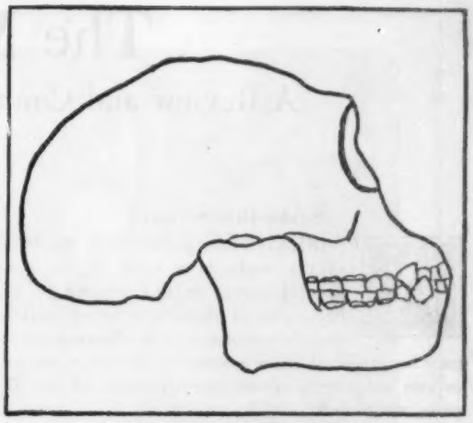
WHERE EOLITHS WERE DISCOVERED

FIGURE 2: *Like any stone, an eolith dropped by early man may ultimately be washed into a gravel bed*



DIAGRAMMATIC CROSS-SECTION OF THE DOWNS AND THE WEALD OF KENT

FIGURE 3: *This shows the enormous denudation that has taken place in this area since eolithic man existed. In the diagram, 1 is chalk; 2 is lower greensand, and 3 is the Wealden beds*



DID HE MAKE EOLITHS?

FIGURE 4: *Pithecanthropus, the ape-man of Java, probably made eoliths similar to those found in Europe*

are of an extreme simplicity, while their color and condition are archaic to a degree. It is, in fact, not possible to conceive of any artificially flaked flint more simple and rudimentary, and the conclusion is inevitable that in these specimens we see the kind of artifact that would be made by a creature just emerging from a simian condition.

But it must, however, be realized that before such a creature became intelligent enough definitely to flake a stone to a desired form, there no doubt passed a very prolonged period during which proto-man was using any stone he could find, with or without a natural cutting edge, for various aggressive and also peaceful purposes.

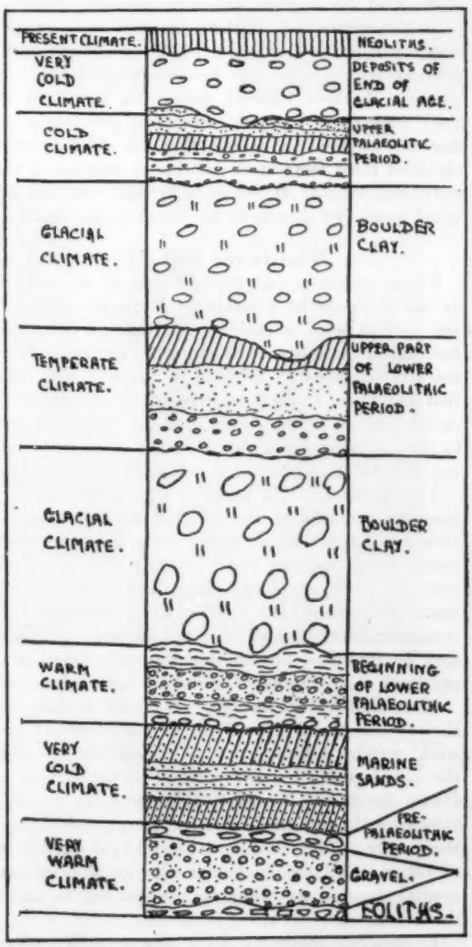
Thus, an ordinary flint with a rounded surface would have been very effective in breaking open bones or shell-fish for their edible contents, or for giving the knockout blow to a human or animal enemy. Such specimens would probably be used once and then thrown away, and little or no signs of the use to which they were put would now be visible. Further, such signs would be indistinguishable from others produced by purely natural means, and thus would fail to provide archeologists with reliable evidence in favor of the high antiquity of man. Even in the case of some flints flaked in a primitive manner, it is not always by any means easy to say with certainty whether they have been fractured intentionally or by the unguided forces of nature, for flints can be fractured, for example, on a sea-beach, by being hurled against one another by the waves. They can be flaked by the pressure of great masses of strata in movement, and lastly, by drastic alternatives of heat and cold.

Aping Eolithic Man

For the archeologist who wishes to stand upon firm ground, it is vitally necessary to become familiar with the characteristics of the various forms of natural flaking, and by means of experiment to gain some idea of the limitations of nature in this matter. The subject of the fracture of flint seems, no doubt, very abstruse and "dry" to the ordinary non-scientific person, but, in reality, it is of consuming interest and wonder and unquestioned importance.

Some years ago, I carried out a large series of experiments in flint-flaking and these convinced me that while nature, by chance, occasionally does some wonderful things in shaping a stone, yet, an examination of her handiwork fails to reveal any signs of this shaping being done for any *purposeful* end. This is as would be expected, and it finally differentiates the eoliths from the results of haphazard natural forces. The same forms, carefully flaked and again and again repeated; the direction of the flake; removing blows, and the characteristics of the flake-scars—all speak eloquently of the artificial origin of the flaking upon these very primitive stones.

When we proceed to enquire into the geological age of the eoliths, it becomes clear that they must be referred to a very remote period of the earth's history. In Kent, England, where many of these implements have been found in a thin deposit of gravel—about 700 feet above sea-level, upon the top of the North and the South Downs—it is evident (Figure 3) that the water which laid down this gravel in which the flints occur, flowed from a high dome of chalk that, at one time existed over the whole of the weald of Kent. Since that epoch, enormous denudation has taken place and there cannot be any doubt that the time involved in this process has been immense.



A MILLION YEARS OF EARTH HISTORY

FIGURE 5: *In this diagrammatic section of the strata of East Anglia the eoliths are shown at the base of the series, whose range of geologic time is coextensive with that of the Ice Age with its four alternations of warmth and frigidity*

In Suffolk, specimens in every way comparable with those found in Kent, have been recovered by me from the Bone Bed beneath the Red Crag (a marine deposit laid down in Early Quaternary times) (Figure 5), and also in certain very ancient gravel beds in the same county (Figure 2). The specimens from both these horizons are, however, rolled by water and had evidently a long history before arriving in the deposit where they are now found. But even so, vast geological and climatic changes have occurred in East Anglia since the Bone Bed and the ancient gravels mentioned were formed (Figure 5), and it is certain that the eoliths are much older than these formations. The measure of their real antiquity may perhaps be gaged by a discovery made at Puy Courney, central France, where definite eolithic implements are found in a gravel associated with the bones of Upper Miocene mammals and overlain by a flow of lava that occurred at the end of the Miocene Epoch.

Evidence Points to Europe

There is, thus, abundant evidence that the eoliths are exceedingly primitive in form, archaic in appearance, and of a great geological antiquity. In fact, in my opinion they provide us with the implements made by the Dawn Men of at least 1,000,000 years ago, and although up to the present no human bones of eolithic age have been found in western Europe, it is highly probable that the simian type of individual (Figure 4) discovered at Trinil, in Java, by Dubois, represents the kind of emergent creature who flaked these rudimentary and enormously ancient flints.

When it is realized that the eoliths have been found in quantity in England and in France, and that from eolithic times onward there has been discovered in these countries an unbroken series of artifacts, representative of every stage of man's prehistoric past (Figure 5), it is inevitable that those who are familiar with these facts, should regard it as quite possible that some part of western Europe was the birthplace of mankind. In the Miocene Epoch to which the eoliths must, it would seem, be referred, this part of the world was enjoying a tropical climate, and would have provided the necessary conditions favorable for the successful inauguration of human evolution.

Whatever discoveries may in the future be made in Asia, it is difficult to imagine them giving us a more complete story of the history of man than has been revealed by archeologists in western Europe and in England.

The Month in Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.

Editor of the *Journal of the American Medical Association* and of *Hygeia*

Snake-Bite Serum

APPARENTLY the poison from the fangs of the snake is a toxin of the same general nature as that created by the bacterium of diphtheria or of tetanus, since a serum against rattlesnake venom may be prepared from a horse in the same manner as one prepares a serum against either of the diseases mentioned.

Colonel M. L. Crimmins has described the method used for collecting the venom from the snake. A large wire paper-fastener is sunk in the end of a wooden whip-stock, with the forked end out, and wired in place. Two leather shoe-laces are tied together to make a strap and passed through the ends of the paper-fastener to create a loop. This is pulled out and passed over the snake's head until it is in place. It is then pulled taut and the snake secured. The snake is grasped behind the head with the left hand so that it cannot turn its head to bite the operator, and its head is held over a sterile dish with the right thumb and forefinger. The poison glands are pressed, which causes the poison to be ejected, through the fangs, into the dish.

The poison dries rapidly and about every ten minutes it is pipetted off, put into tubes, and dried further in an incubator so that it becomes crystallized. Specimens are kept for purposes of identification. The major portion is centrifugalized and the upper layers are used for injections into the horse. Two hundred Texas, diamond-back rattlesnakes produced two ounces of liquid poison.

Radioactivity of Natural Waters

DR. W. D. COLLINS of the United States Public Health Service recently investigated the radioactivity of most of the natural mineral waters available in the United States. He concluded, on the basis of the extensive data that were accumulated, that the radioactivity found in natural waters has no effect on their medicinal value.

Some years ago, the Council on Pharmacy and Chemistry of the American Medical Association concluded not to approve any radium solution for internal use when the dosage was less than two micrograms a day. It was estimated that a person would have to drink a gallon of water a day in order to obtain this dose provided that the radioactivity of the water was 500 millimicrocuries per liter. This unit of radioactivity corresponds to one-billionth gram of radium.

Photograph by Smithers

CAPTURING A SNAKE

The two snaring devices shown are described in complete detail in the text above

Photograph by U. S. Signal Corps

EXTRACTING THE VENOM

The snake is grasped so that it cannot bite, the poison glands are pressed and the poison is ejected

Many of the mineral waters of this country range in radioactivity below three millimicrocuries per liter, and the best of them barely reach 30 millimicrocuries. Claims are frequently made for the potency of these mineral waters on the basis of their radioactive content. Skeptical physicians today are inclined to believe that the chief benefits obtained from the waters are due to exercise in the open air, change of scene, sufficient rest and the usual good diet that is to be found at the spa.

Who Is the Father?

UNTIL recent years, the question as to whether or not it would be possible to determine definitely the parentage of a child by a study of its blood has been answered with an emphatic negative. More recently scientists have begun to apply to this question the facts learned relative to the grouping of certain bodies in the blood, and are now prepared to say, in many cases, that a certain man could not possibly be the father of a certain child.

The discovery, like many others in the field of medicine, represents the gradual accumulation of facts over a period of years, some of them, when made, being without apparent significance. They were of the type commonly called nonproductive research, because the results were apparently of academic interest only. Later, however, such facts may be found of utmost importance in relation to practical applications of scientific knowledge.

More than 20 years ago, a German investigator showed that there are, within the blood of all persons, certain substances with the power to cause the blood cells of other persons to agglutinate or clump together. It was found that there are also substances in the blood of some people which have the power of dissolving the red blood corpuscles of others. All human beings may be divided into special groups, according to the manner in which the blood reacts to these tests.

In general, there are four groups with various percentages of persons in each group. Later it was found by investigators in Germany, Japan and the United States that these powers are inherited to a certain degree, and that the inheritance follows definite lines, as, for instance, has been proved for the inheritance of the color of the eyes and even of certain senses. For example, a marriage between parents of group 1 and group 4 can result only in children of groups 2 and 3; marriage between parents who are both of group 1 can bring about children only in group 1; groups of 1 and 2, and of 2 and 2, can result only in children of groups 1 and 2.

In these tests it is merely necessary to take some of the blood serum of the patient and to test it against certain standard blood preparations from persons whose blood grouping has been definitely identified. The tests themselves are relatively simple and can be performed by anyone familiar with laboratory technique in blood study.

It is obvious that it cannot be said definitely from these tests that a certain man is the father of a certain child. On the other hand, it can be said that he could not possibly have been the father of the child. One German scientist cynically remarked: "Men are always willing to submit to the test, since it may exonerate but cannot incriminate them."

The Composition of Sweat

SOME people perspire more than others. For years physicians have felt that sweat had a useful function in aiding to eliminate elements that were not eliminated through other channels. Investigators in the University of Michigan have been giving special attention to the composition of sweat because they felt it might contain irritating substances which would produce disturbances of the skin, as, for example, the eczema that occurs in very old persons.

Sweat baths were given to a number of patients who volunteered for the tests, and in one case a patient perspired 830 cubic centimeters, or about a pint and a half, of sweat in one hour. Perspiration from 17 normal people was examined as to its content of chlorides and nonprotein nitrogen. Patients with eczema and with psoriasis were found to put out the same amounts of chlorides as did normal people, although the amounts of nonprotein nitrogen and urea nitrogen were somewhat higher for persons with eczema than from the normal patients. Uric acid was not found in significant amounts in the sweat of either normal or diseased persons.

Photograph by U. S. Signal Corps

ONE OF THE CAPTIVES

Poison extracted from rattlesnakes can be used for making an anti-snake-bite serum

IT IS EASY BY THE TOUCH SYSTEM

Blind newsdealers, salesmen and other business men type out their reports and statements in the evenings on standard-keyboard machines

THE LIGHTHOUSE SERENADERS

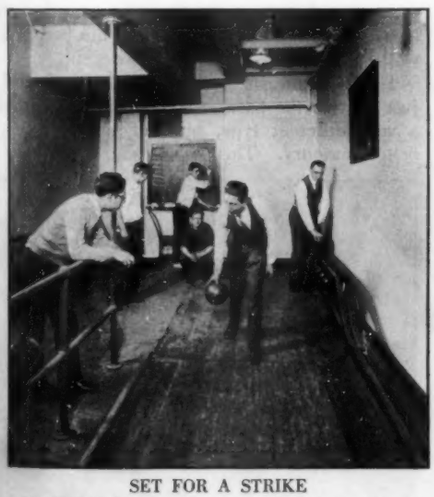
Their syncopation makes feet just as restless as any other good orchestra. All the usual instruments are played and unusual talent is exhibited

IN THE CORNER POCKET

These men can distinguish light and dark. White balls against a black cloth on the table and powerful lights make it possible to play pool

CONCENTRATION IS NECESSARY

Cards with Braille markings and square and round checkers fitting into square holes make games easy and so aid in passing the time away

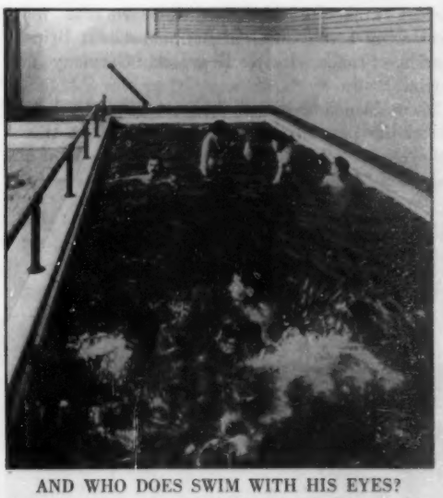


SET FOR A STRIKE

Totally blind men easily get a sense of direction by grasping the ball rack as they run forward

"ALL TOGETHER, RIGHT FOOT FORWARD!"

Blind men naturally are timorous and awkward. Dancing instruction develops ease of movement



AND WHO DOES SWIM WITH HIS EYES?

Blind boys learn just a little slowly, only because they cannot see how the instructor does it

Blind Folks "See" Lots of Good Times

Have you ever seen a blind man on roller skates tapping his way around with a cane? Have you seen a blind stenographer taking down dictation at the rate of 70 words a minute and then transcribing her notes on an ordinary typewriter? Have you seen four blind women playing bridge? Or a blind man rolling balls down a bowling alley and running up a score of 217? We have seen all of these things and a hundred others just as unusual. The most remarkable fact of all, however, is that the people who do these things do not seem to consider them at all out of the ordinary. Such pastimes take place at the Lighthouse, a place operated by the New York Association for the Blind and supported by contributions from warm-hearted persons who feel that it is the job of those with eyes that can see to help those who live in the dark. In the Lighthouse, approximately 2,700 wholly or partly sightless persons every year are helped to help themselves. Generally speaking, about one person in every thousand is blind, which means there are about 5,000 blind in New York City and about 100,000 in the United States. By no means, however, are these helpless dependents. Terribly handicapped though they are, they can work and play as you and I do, although it takes perseverance, will power and optimism such as all of us might envy. Many businesses are successfully conducted by blind or partially blind persons.

Photograph by American Colony, Jerusalem

MUSEUM OF THE PALESTINE DEPARTMENT OF ANTIQUITIES IN JERUSALEM

This structure was built by the Palestine Government, after the World War. It is already crowded with objects discovered in excavations in Palestine

Buried Secrets of the Holy Land

All Over the Bible Lands, from Dan to Beersheba, the Archeologist Is Busy Turning Over Ancient Mounds and Revealing City Sites

By Harold J. Shepstone

Fellow of the Royal Geographical Society

PALESTINE, that little land of sacred memories, tucked away at the dead end of the Mediterranean, is today the scene of many interesting excavations. Indeed, there are no less than eleven different archeological expeditions in the field, representing seven different nations—Great Britain, America, France, Italy, Denmark, Germany and Austria.

This sudden activity on the part of archeologists to read the past history of the land can be traced to the efforts of the Antiquities Department of the Palestine Government, of which Professor Garstang is the head. Under the Turks, excavation work in Palestine was not only costly, but the restrictions imposed were very irritating. Today, under the British, every encouragement is being given to a scientific examination of the mounds and sites which are known to mark places of historic interest. Furthermore, valuable work is being undertaken in preserving the existing ruins. As I write, they are busy reconstructing from the ruins an ancient synagogue at Capernaum, believed to be the very one in which Christ taught, and in the near future tourist and scholar will be able to stand in the very building in which Christ addressed the people.

Photograph by American Colony, Jerusalem

PRIMITIVE THRESHING AT JERASH

In Roman days cows trampled out the grain in exactly the same primitive manner. It was at Jerash that a sculptured head (of Christ?) was recently found

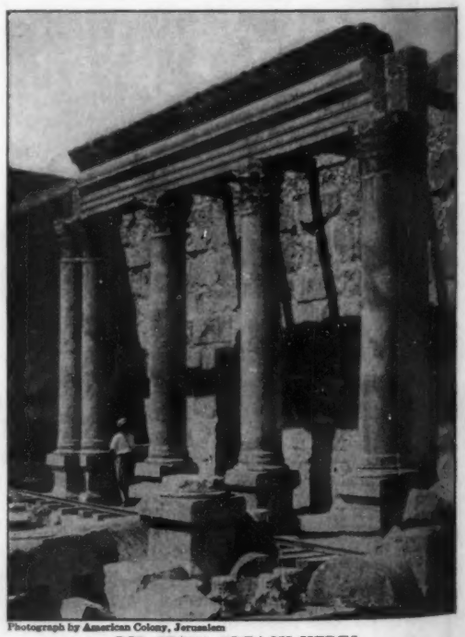
Unearthing the Walls of Jerusalem

One of the first acts of the Antiquities Department was the building of a museum in Jerusalem, to which all the more valuable objects found in the country are sent and exhibited to the public free of charge. Although only a few years old, the institution is crowded with a varied collection of relics in the way of monuments, tombs, columns, entablatures, caps, bases, pottery, glassware, domestic utensils, coins, et cetera, gathered from all parts of the country, objects which carry the history of the land back many thousands of years.

There have also sprung into existence two schools of archeology in Jerusalem, one founded by the British and the other by the Americans. Hence Jerusalem has become the gathering place of archeologists working in the East, and it was in the Holy City that they decided to hold their International Congress last September, which was attended by delegates from 13 different countries, including an envoy from the Vatican.

Jerusalem itself has been the scene of much archeological activity during the past few months. On the site of Ophel, to the south of the present walls of the city, excavations have been made both by the Palestine Exploration Fund and Professor McAlister. They have dug down to the ancient level, and discovered a part of the wall that enclosed the ancient Jebusite city. It is built in the slanting manner, each course of stones being farther in than the one below it. This is the same kind of Canaanitish fortification as has been found at ancient Jericho and other Canaanitish ruins; it is the bastion, above which stood the perpendicular wall.

The Canaanitish wall continues southward, but just next to the bastion there is a corner tower of a very different type, built of larger stones, and better masonry. This is Davidic work, and, as it



Photograph by American Colony, Jerusalem

DID JESUS PREACH HERE?

Dr. Père Orfali, a Franciscan, located the ancient city of Capernaum, on the Sea of Galilee. He found this temple, in which many believe Christ preached

intervenes in the gap in the Canaanitish wall, is thought to be the "breach" which David is recorded to have built up, and may be the "millo" which is often mentioned in the Old Testament, and which actually means a "filling up." To the east of this, there is a wall of a later period, which lies outside of the Canaanitish rampart; it is virtually the finest of all and is attributed to Hezekiah. It has been suggested that it was between these two walls that Zedekiah and his men escaped, when the city was beseiged by Nebuchadnezzar.

Interesting also is the work which has been carried out by the Jewish Palestine Exploration Society in uncovering the foundations of the third, or most northernly wall of Jerusalem, built by Agrippa I, grandson of Herod, to protect the new residential quarters that were then rising outside the northern wall of the city. As a result of the excavations it is now possible to make a reconstruction of the wall from a point opposite the tomb of Queen Helena to the Russian Square, some 1,600 feet in length.

America Contributes

The northern side of Agrippa's Wall is now definitely fixed. During the excavations, foundations of a large public building dating back to the Byzantine period were uncovered. The forthcoming task of the Society will be to discover a connection between the Third Wall and the line of the Second Wall, which enclosed the city in the days of Christ. If the course of the latter wall were ascertained it would at once settle the vexed question as to whether the Church of the Holy Sepulchre, which marks the alleged site of the Crucifixion and Burial lies outside the city or not.

In actual field work the American universities are certainly to the fore. For every dollar the other nations are spending Uncle Sam is contributing at least ten. Furthermore, American experts are toiling upon the more promising sites. To the south of Hebran, Dr. W. F. Albright, Director of the American School of Archeology in Jerusalem, has located the site of the library city of Kirjath Sepher. Since the discoveries in Babylon and the Hittite country of libraries of thousands of baked clay tablets, hopes have been entertained that in Palestine similar finds may come to light.

The site that especially attracted attention was Kirjath Sepher, for the name implies the "town of books," or library. It is referred to in Joshua in connection with the story of Caleb, one of the two spies who brought a good report of the land. But no one knew definitely where the ancient city stood. Dr. W. F. Albright was successful in locating it some 15 miles southwest of Hebron.

Here he has been toiling with most interesting results. He has laid bare a portion of the old city wall and two well-preserved gates, practically the first of the early Israelite period yet found in Palestine. The sloping revetments of the walls, which varied from 10 to 12 feet thick, and probably towered 30 feet in height, not only date back to the Canaanite period, but resemble those found at Jerusalem and Jericho. The buildings were evidently made of white, compact, sun-dried bricks, 13 by 10 by 8 inches in size, such as have not been met before. A couple of hundred pottery vessels of various shapes and sizes were found as well as clay weavers' weights, dyeing vessels, pestles, mortars, and sling stones.

A shaft sunk on the site, reaching down to the level of the base of the wall where it was laid bare, seems to indicate that there were five periods of occupation, each followed by the burning of the city. The third, fourth and fifth destructions were probably the work of Othniel, Calib's nephew; Shishak, king of Egypt, in the time of Solomon; and Nebuchadnezzar of Babylon. So far, however, the search has failed to reveal the existence of any clay tablets.

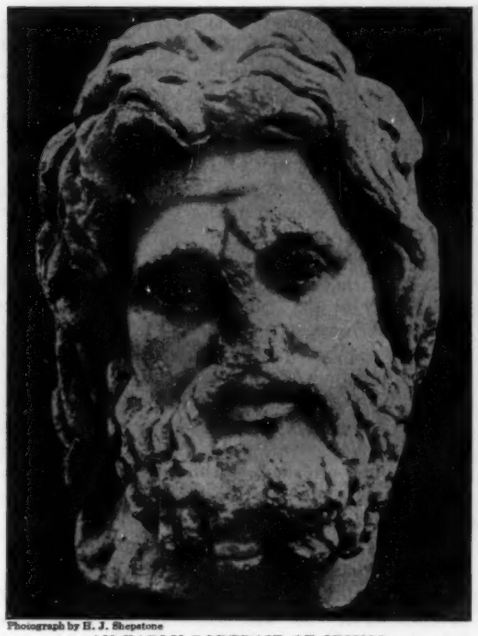
Some seven miles to the north of Jerusalem, not far from Ramallah, Dr. W. F. Bade of the University of California, has been digging over the site of ancient Mizpeh. We know from the sacred narrative that Mizpeh was a strongly fortified position, and it was here that Samuel judged Israel for 20 years. Quite early in the work a city wall was struck, so massive as to alter all preconceived notions of the strength of ancient fortified cities in Palestine. The wall averaged 16 feet in thickness. A large cistern was found, believed to be the one in which Ishmael threw the body of Gedaliah after he had slain him. It is the belief of Dr. Bade that the earliest inhabitants of Palestine, between 3000 and 2000 B. C., were not of Semitic stock.

The City of Saul Excavated

Not far from Nablous, on the site of ancient Shechem, where, prior to the war, the ruins of the palace of Ahab were unearthed—the only one so far found of a Hebrew king—Professor Sellin of Berlin is at work, with promising results. Shechem was ancient long before Jerusalem was built, first as a fruitful valley where Abraham and Jacob rested, and then as a prosperous city. An Egyptian tomb inscription mentions it as among the conquests of the Pharaoh, Sesostris the Third.

Excavations are also to be resumed at Bethshan, or Beisan, in Galilee. In 1925 an American expedition from the University of Philadelphia dug over the site when the two temples of the Philistines mentioned in the First Book of Chronicles, in one of which the armor of Saul was placed and in the other his head, were found.

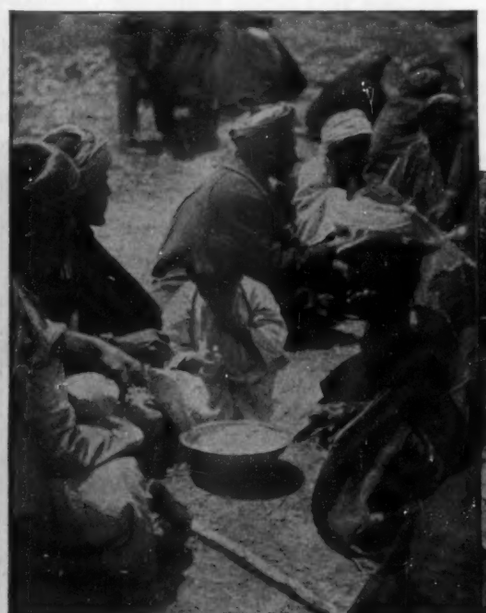
Beisan and the surrounding districts are replete with Biblical associations. On one side of the fertile and picturesque valley in which the city reposed rises the Mountains of Gilboa, on which Saul took his life, and on the other side the lower hill-slopes



Photograph by H. J. Shepstone

AN EARLY PORTRAIT OF JESUS?

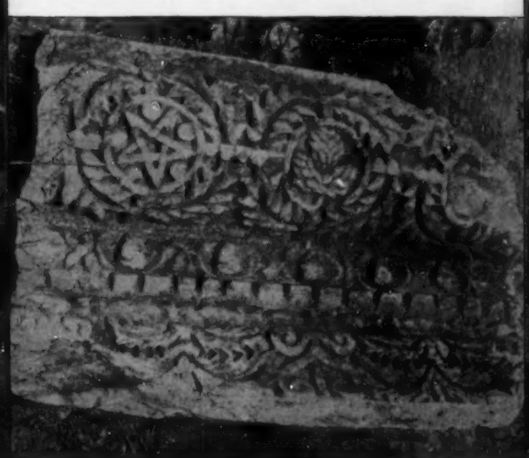
This portrait head was found in ruins of an ancient temple at Jerash, in Transjordania, and is thought by some to be a representation of Christ, made within seventy years of the crucifixion



Photographs by American Colony, Jerusalem

THE WORKERS' FEAST

At the close of the season's work the diggers feast in celebration. Their wants are few and their labor is not costly. Excavating machinery would damage the ruins



FOUND AT ANCIENT CAPERNAUM

This frieze and cornice with five-pointed star and grapes was found in the ruins of the same temple from which the supposed portrait of Christ was taken

DID CHRIST WALK HERE?

Jesus is said to have preached at Capernaum (Matt. 4, 13), *probably in the synagogue of which this is the eastern staircase. This synagogue is being reconstructed*

Photograph by American Colony, Jerusalem

SARCOPHAGUS FOUND NEAR CAESARIA

"And the next day we that were of Paul's company departed, and came unto Caesaria: and we entered into the house of Philip the evangelist, which was one of the seven; and abode with him."—The Acts of the Apostles, 21, 8

of Little Hermon. Nearby is Jezreel where Jezebel lived, and also Endor, where Saul consulted the witch. Along the roadway through the valley the Philistines brought the headless body of Saul and his two sons, and here came the bloody chariot of Ahab bearing his lifeless body to Samaria. Here drove the fiery Jehu to execute divine vengeance on kings and false prophets and to seize a throne. All that remains of Beisan today is a large mound 200 feet in height, which covers the ruins of several cities, for it is one of the oldest city sites in the world.

As a result of the 1925 excavations four Canaanite temples were found, two of which had been built during the time of Rameses II—one in the reign of his predecessor, Seti I, and one in the Tell el-Amarna era. The evidence shows that the southern temple of Rameses II was dedicated to the warrior-god Resheph, and the northern one to the warrior-goddess Antit-Ashtoreth, whose monument was discovered in the building. Until lately it was thought that in the time of Rameses III the latter temple was in disuse, but the new details show that such was not the case. As a matter of fact, from the time of the erection of the buildings up to the time when King David drove out the Philistines, worship was carried on in both the temples, first by the Egyptians and then by the Philistines.

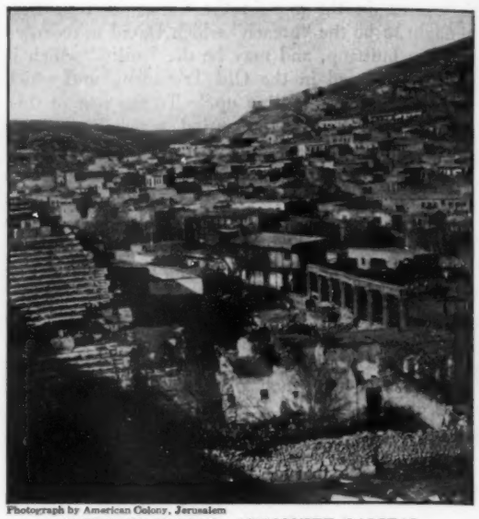
Austrian excavators are at work digging out the records of Taanach, the Canaanitish town allotted to Manasseh, and mentioned in the song of Deborah, while at Megiddo, American archeologists have found signs of the worship of Ashtoreth. Around Tabgha, on the northern shores of the Sea of Galilee, attention is being given to a more minute examination of the huge limestone caves found here. It was in one of these caverns that Mr. Turville-Petre found the skull of a Neanderthal man who lived at least 20,000 years before the time of Abraham.

At Chorasin, a short distance from Capernaum, Mr. J. Ory of the Antiquities Department of the Palestine Government, is conducting some interesting excavations. Among the ruins he has found a synagogue dating from the second or third century. It was two stories high, the upper one being a women's gallery. The stone used was black basalt which is found in the Galilean hills. The friezes of the capitals are adorned with pomegranates, dates, citrus fruits and other Jewish religious symbols.

The Motorcar in Holyland

At Capernaum a column is to be erected commemorating the late Dr. Père Orfali's recent discoveries there. He was rector of the Franciscan School of Archeological Research and president of the Palestine Oriental Society. It was Dr. Orfali who definitely located the site of Capernaum, called Tell Hun, at the northern end of the Sea of Galilee. Here he found the extensive ruins of a first-century building in the Roman-Corinthian style, which is now accepted by many scholars as the synagogue built by the Centurion of the gospels and the one in which Christ preached. It was largely composed of white limestone resembling marble. It is about 75 feet long and 54 feet wide, the outer walls being built of very large blocks of stone. The bases of the columns are still intact, although the pillars themselves have fallen. The latter are adorned with beautiful capitals and the lintels were profusely ornamented. None of the stones of which this building was constructed appear to have been removed, and the synagogue is now being reconstructed.

The decision of the Antiquities Department to take steps to preserve the ruins in Transjordania, that vast tract lying on the eastern side of the Jordan, is a commendable one. Scattered over this immense area there are many magnificent ruins—palaces, temples, towers, theatres and tombs—dating back to quite early times. There is Amman, the present capital, the Rabbath-Amman of Old Testament history and the Philadelphia of late Egyptian and Roman days, with its citadel; Jerash, with its



Photograph by American Colony, Jerusalem

MODERN AMMAN, AMMONITE CAPITAL

In Roman times Amman was an important city, being one of the Decapolis (Matt. 4, 25). *The grand Roman theatre at the left seated at least 4,000 spectators. Amman is the capital of the modern Ammonites*

Temple of the Sun; Kerak, with its mighty fortress; and Muschetta with its delicate carvings, to mention only a few. Transjordania was the land of the Ammonites and the Moabites. Amman can be reached by motor car from Jerusalem in six hours, and its ruins are among the finest to be seen east of the Jordan.

To the north of Amman lies Jerash, with its ancient gates, old walls, theatre and the remains of the Great Temple of the Sun in which Baal was worshipped. The latter stands upon a terrace 527 feet long and 334 feet wide, and was enclosed by 260 columns. Those columns that remain make an imposing appearance, and when the sun shines upon them they assume a delicate yellowish-pink color. It was while superintending certain repair work among these ruins that Mr. Horsfield of the British School of Archeology in Jerusalem, stumbled across a sculptured head dating from the latter part of the Second Century and believed by many scholars to be a portrait of Christ.

We know from ancient records that Christianity superseded paganism in this beautiful city. Baal's temple was converted into a Christian church and Jerash, in due course, became the seat of a bishopric. The city continued wealthy and prosperous until the Second and Third Century of our era, when it is believed to have been overthrown by an earthquake.

Photograph by American Colony, Jerusalem

MORE RUINS OF CAPERNAUM

"And thou, Capernaum, which are exalted unto heaven, shalt be brought down to hell; for if the mighty works which have been done in thee had been done in Sodom, it would have remained until this day."—Matt. 11, 23

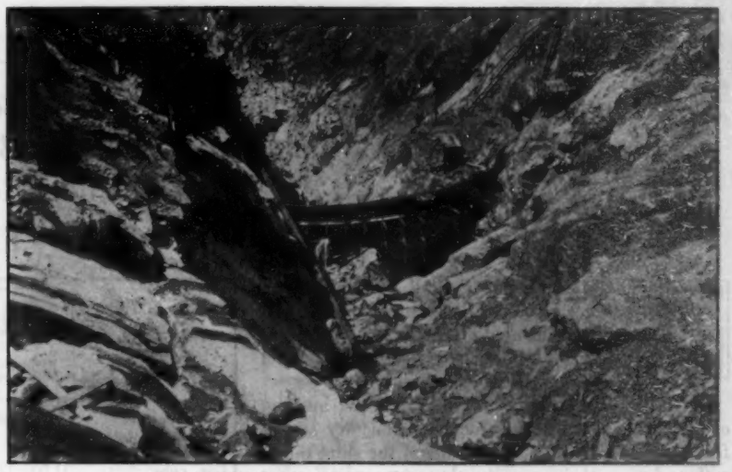
Photograph by H. J. Shepstone

UNCOVERING JERUSALEM'S ANCIENT WALL

During last year, considerable progress was made by the Jewish Palestine Exploration Society, in uncovering the foundations of the third or most northerly wall of Jerusalem. This is often called "Agrippa's wall"

THE TERMINAL BOARD AND CONNECTIONS

Hundreds of wires lead from special recording instruments along the face of the dam, which automatically record any movements which take place under various heads of water



THE STEVENSON CREEK EXPERIMENTAL DAM

This dam, built in the foothills of the Sierra Nevada Mountains, California, was built under the Engineering Foundation of New York, to determine stresses in concrete dams

Testing a Dam to Destruction

An Experimental Arch Dam, Built to Determine the Exact Stresses with the Water at Various Levels

WORKING on the assumption that, up to date, no accurate data has been obtained on the exact character and amount of the stresses in a concrete dam, the Engineering Foundation of New York recently sponsored the construction of a purely experimental dam at a cost of 100,000 dollars, which has been built on Stevenson Creek, 62 miles east of Fresno, California, and tests are now being made under the direction of the United States Bureau of Standards.

The dam is 60 feet high, 140 feet long on top and ranges in thickness from seven and one-half feet at the base to two and one-half feet from the 30-foot level on up to the top. Beginning with five feet of water, tests have been made by engineers up to the full 60 feet and plans for extending the dam up to 100 feet high at the same thickness and for making tests until the dam collapses are now under way. As the dam holds only five and one-half acre-feet of water, only a little over an hour is required to fill it to the top. The water, as soon as tests have been completed, is released for irrigation purposes. W. A. Slater, engineer of the United States Bureau of Standards, has been supervising and recording the results of the tests, and he is assisted by a corps of eight young engineers from various universities.

The Stevenson Creek dam, which is in the foothills of the Sierra Nevada mountains, is said to be the only purely experimental dam of its type in America. Engineers believe that millions of dollars may be saved in dam construction when the set of tables computed from the present set of tests is available. It is believed that the guesswork and waste that has accompanied the construction of many of the great hydro-electric and irrigation projects in the country can now be eliminated.

Special Instruments Used for Tests

Tests are being made for all kinds of stresses and deviations, all the ordinary instruments for such purposes being used and rechecked with other specially constructed instruments used for the first time on this job. Variations in the structure of the dam and movements up to or rather down to one millionth of an inch are being recorded. Tests are made for arch and cantilever strains. Strain gages buried two inches deep in the concrete of the dam register, through telemeters, on an instrument board beside the dam; clinometers are used for measuring deflections or movement of the dam under pressure; level bars are employed to record tipping over from the foundation; radius meters also measure deflection; and theodolites measure deflection by computing angles from points on the dam to points on bed rock, et cetera.

These tests are made from all over and all through the dam, from top to bottom, and from side to side. One thousand strain-gage points with 533 lines are employed; 150 electrical telemeters are used; 80 radius-meter lines run from various points on the dam; 60 deflectometers, 60 clinometer stations, and 12 level-bar stations are in use.

Wires lead from all over the dam to telemeter stations beside the dam, where engineers record stresses and temperatures on electrically operated testing sets. Most of the tests are conducted at night when temperatures are most even.

As stated by one of the engineers on the project: "The purpose is to get accurate data on stresses in arch dams for future designs of dams. Up to now tests have been merely mathematical and assumptions have been frequent, factors of safety too high, and the total result unsatisfactory. We believe the results of the tests so far have been very satisfactory. Our instruments have been working smoothly and where our observations have been rechecked, one instrument against another, the results have been reassuring."

The concrete used in this dam is one part cement, three parts sand and two parts rock, the aim being to make concrete of average strength. Asked if the dam had shown any signs of weakness with 60 feet of water behind it, the engineers pointed to a tiny fissure near the center of the dam and said that while this fissure had widened when water was being turned in behind the dam, it had later closed when water pressure increased due to the arch action. They expressed the belief that it in no way predicated the collapse of the dam.

A VERTICAL CLINOMETER

One of the several instruments used to record any movement of the experimental dam under various water pressures

TAKING MEASUREMENTS WITH A TELEMETER

Strain gages, buried two inches in the concrete, register through telemeters on an instrument board near the dam

The Carbonization of Coal at Low Temperatures

Coal Smoke Is Not a Necessary Evil; It Represents Wasted Fuel. New Processes Which Will Turn This Waste Into Valuable By-products Are Being Developed. What Is Their Real Significance?

By H. W. Brooks

FROM time immemorial, the smoke nuisance has been the ever-present incubus of the burning of coal, the world's most abundant and otherwise most perfect fuel.

In 1550, Queen Elizabeth prohibited the burning of coal in London during the Parliamentary season for fear "the health of the knights of the shire might suffer during their stay in the metropolis." Yet through the centuries, thousands of lives and billions of dollars worth of damage to clothes, property and vegetation has been the toll of this smoke. Coal has made possible America's marvelous industrial era of the past three decades and now, paradoxically, our cities are wailing lustily for smoke abatement and with equal vociferation demanding well-laundered workshops.

What Is "L. T. C."?

It was recognized early that smoke was but an indication of the partial and inefficient combustion of certain gaseous constituents of coal, and that the best way to eliminate or minimize it was to separate the solid from the gaseous components, burning each subsequently in furnaces particularly adapted for their use. Dr. H. C. Porter, in his valuable treatise on smoke, defined coal carbonization as "a process of modifying a crude, raw fuel into better fuels; of extracting valuable by-products—ammonia, light oils and tar—before they are destroyed in the burning, of converting the raw, smoke-producing, inefficiently handled coal into a clean and smokeless gas or coke, efficient in use and in distribution."

One cannot review the history of coal carbonization without being impressed with the fact that the initial and fundamental idea has been paramount in promoting the comfort, health and economic betterment of the public by substituting some more efficient medium than raw coal for the generation of heat. Nevertheless, the entire way behind us is sadly smudged over with soot, and we are all eager to know whether clear skies and sunshine are just ahead.

Yield per Ton of Coal Treated.	High-temperature Carbonization.	Low-temperature Carbonization.	
	By-product Coke Oven.	Externally Heated Retorts.	Internally Heated Retorts.
Coke, percent	60–70	70–80	60–75
Volatile matter in coke, percent....	1–2	7–15	7–15
Gas, cubic feet....	11,000–12,000	3,000–5,000	20,000–50,000
Calorific value of gas, B.t.u. per cubic feet	520–550	800–1,000	150–250
Tar, gallon	10–12	20–28	18–20
Specific gravity of tar	1.19	1.07–1.09	1.02–1.07
Light oil for motor fuel, gallon	2.5–3.0	2.5–3.0	None
Ammonium sulfate, pound	25–30	10–12	12–18

FIGURE 1

A comparison of the products obtained from the present-day treatment of coal with those of the new method

What, then, is "low-temperature carbonization" and why is it so called? A little over one hundred years ago, Murdock of England and Lebon of France established the gas industries of their respective centuries. The first gas companies were established in the United States at Baltimore in 1819, at Boston in 1822 and in New York in 1825. Yet it was not until the close of the Nineteenth Century that any notable advances over the initial discovery of the process of carbonization by Murdock and Lebon were made. For substantially 75 years, the carbonization of coal was carried on in the same way and at the same high temperature of from 950 to 1,200 degrees, Centigrade, or 1,750 to 2,100 degrees, Fahrenheit, as at the outset, with small attention devoted to further modification or improvement.

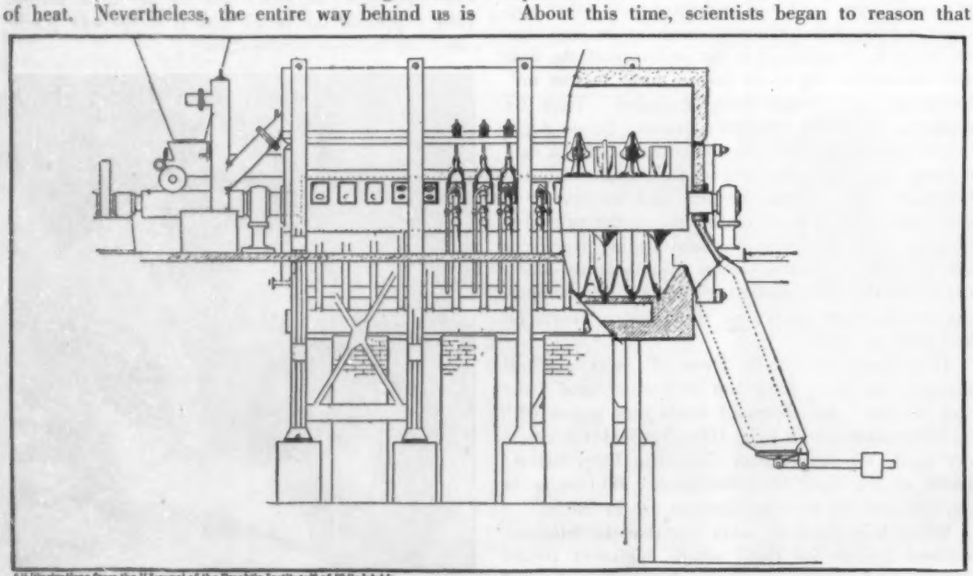
About this time, scientists began to reason that as there were many ways of cooking beef to suit different tastes, so there might be correspondingly different ways of cooking coal the better to suit differing economic needs. In fact, except for the temperatures used, the processes apparently were strikingly similar. Like steak, coal can be grilled over a fire—either rare, medium or well-done. You can roast either beef or coal in an oven. You can boil them over a fire and make soup of them. By so doing with the beef, you can convert what originally appeared to be a solid into three beneficiated components—a solid food in the form of a "roast," a liquid food as "soup" or "gravy," and a gas, that is to say, an aroma, which pervades the home to stimulate the appetite!

Hitherto, in carbonizing coal, we had cooked it only "well done," and for each ton of coal we had obtained thereby, of beneficiated solid fuel, 60 to 70 percent; of viscous liquid tar, about 10 to 12 gallons; of city gas, about 11,000 to 12,000 cubic feet, and of ammonium sulfate (a fertilizer base), about 25 to 30 pounds.

Cooking Coal "Rare" or "Well-Done"

About 1890, Mr. T. Parker in England conceived the idea of cooking coal "rare" at from 450 to 600 degrees, Centigrade, or 850 to 1,100 degrees, Fahrenheit, as well as doing this by a continuous process rather than by the intermittent charging and discharging of the high-temperature coke ovens, whose temperatures did not permit the introduction of moving parts without prohibitive maintenance cost. Furthermore, many weakly-coking coals might be coked which, with the high-temperature methods, were unutilizable. Being done at much lower temperatures than the previously known process, such coking methods became generically known as "low-temperature carbonization."

Out of the Parker patents has grown up a technique of continually increasing promise to a modern civilization whose cornerstone is fuel converted into



All illustrations from the "Journal of the Franklin Institute" of Philadelphia

FIGURE 2

Few full-scale, commercial installations for the low-temperature carbonization of coal ("L.T.C.") have as yet been made. Of these, the McIntire retort at Fairmont, West Virginia, is one of the least new

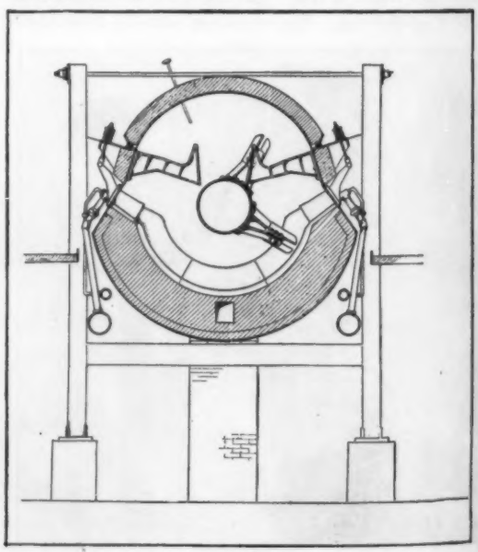


FIGURE 3

In the McIntire retort, the coal is kept moving by paddles, as shown in this cross-section of the device

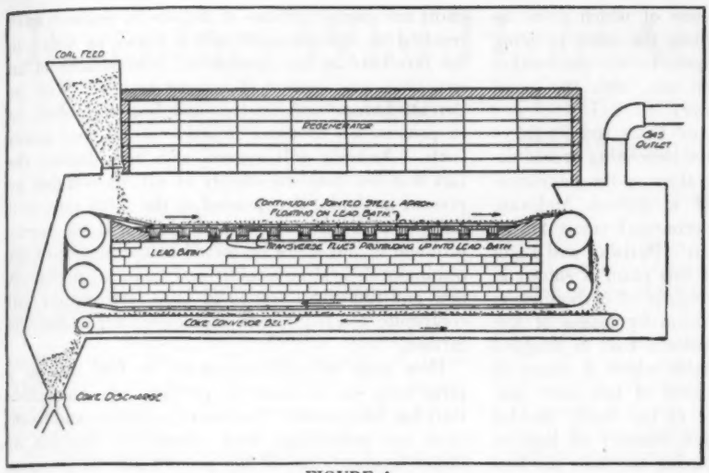


FIGURE 4

The Piron retort at the Ford plant is in actual commercial operation at present. The method of heating the coal is interesting: it floats on molten lead

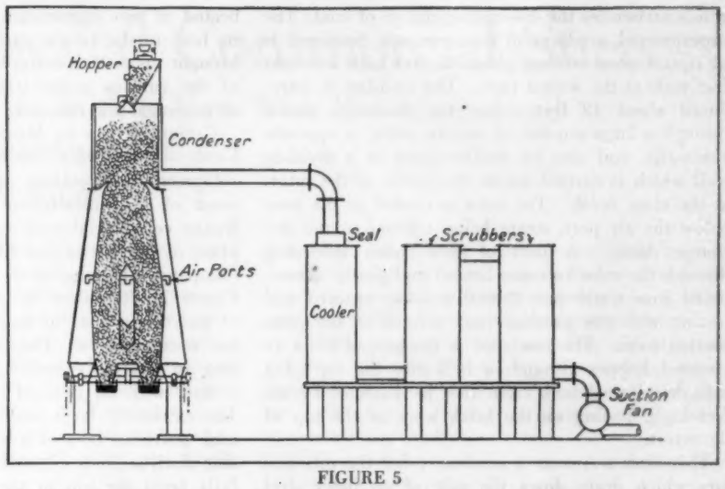


FIGURE 5

The McLaurin vertical retorts in Scotland have also settled down to regular production, but the majority of the processes are still in the experimental stage

heat and power. Last year David Brownlie of London, a noted British authority, advised the author that in the preparation of his contemplated book on "low-temperature carbonization" he had discovered to date over one hundred and twenty processes, and something like eight or nine hundred patents. By these methods have been produced from each ton of raw coal, of solid, smokeless fuel (generally called "semi-coke," superior as a domestic fuel to high-temperature coke), about 70 percent; liquid tar oils, free-flowing and not much heavier than water, from 20 to 30 gallons; gas, almost twice as rich as city gas in its heating value, about 4,000 to 5,000 cubic feet; and ammonium sulfate, some 10 to 15 pounds.

What, asks the general reader, does low-temperature carbonization produce?

Apparatus for the low-temperature carbonization or "distillation" of coal may be divided into two classes, the first heated externally, heat being transmitted from outside the oven or "retort" through a wall, the second heated internally, carbonization being effected directly by hot gases passing through the charge of coal. Figure 1 shows comparative primary yields of these two methods and their relation to high-temperature yields.

An American Installation

The apparatus for external heating may be further subdivided into stationary and rotary retorts. The stationary retorts may be of the shaft type, the horizontal type, or of the tunnel kiln type, as will be described later. Figure 8 shows in somewhat greater detail the yields, both primary and secondary, of the Thyssen (German) rotary retort as given the author by the former chief engineer of the Thyssen company.

EXTERNALLY HEATED VERTICAL RETORTS: The original Parker "Coalite" process utilized the principle of an externally heated vertical retort. An installation of two batteries of 32 vertical retorts, each battery designed to carbonize 50 tons per 24 hours, has been installed at Barugh, Barnsley, in Yorkshire. Each retort consists of an iron casting in one piece, containing 12 vertical tubes tapering from four and one-half inches internal diameter at the top to five and one-half inches internal diameter at the bottom, and nine feet long. The structure might be likened to a vertical water-tube boiler, with coal instead of water filling the tubes, the tubes tapering out toward the bottom. The retorts are heated by burning a mixture of low-temperature gas and producer gas in the combustion chamber surrounding the retorts.

EXTERNALLY HEATED HORIZONTAL RETORTS: Of the externally heated retorts of the horizontal type, probably the most interesting in America is the McIntire retort shown in Figure 2. The coal is fed into one end and the semi-coke is discharged from the other.

As shown in Figure 3, a series of paddles carried on a central rotating shaft moves the coal along the bottom of the retort, agitating it at the same time. The heating is done along the bottom surface over which the coal is being conducted, and the resulting coke is discharged in small pieces, due to the agitation. This fine coke can be briquetted with a pitch binder, recarbonized and used as a domestic or producer fuel, or screened out and fired in pulverized fuel furnaces.

EXTERNALLY HEATED TUNNEL KILN TYPE RETORTS: Representative of the tunnel kiln type of retort are the well-known Ford installations of the Piron retort, one of which is shown in Figure 4.

In this example, the coal is conveyed through a closed retort on an iron conveyor which floats across the surface of a molten lead bath. The heat of the lead devolatilizes the coal, and the coke is carried out and discharged from the conveyor belt. It is claimed that a layer of coal one-half inch thick is completely carbonized in five minutes at a temperature of 650 degrees, Centigrade. The fire-brick retort is about 50 feet long. Gas is the source of heat for maintaining the lead bath at the required temperatures. The products of combustion pass through narrow passages under the bath, into the checker brick regenerator settings overhead. The semi-coke delivered is not in a suitable form for use as a domestic fuel, it being the intention to pulverize the greater portion of it for steam-raising purposes.

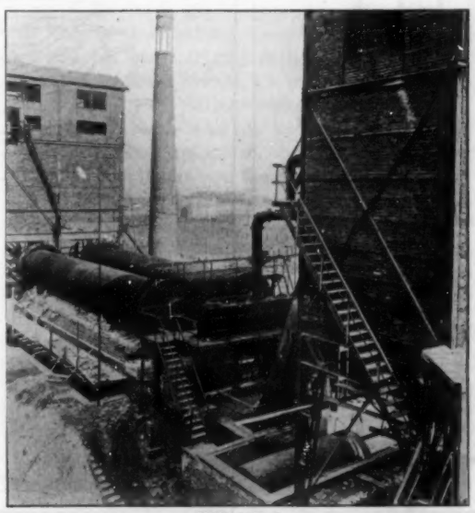


FIGURE 6

The Thyssen rotary retort in operation in Germany. Its many products are shown in Figure 8

EXTERNALLY HEATED ROTARY RETORTS: Rotary retorts have found special favor in Germany and to some extent in England. The first rotary retorts of really large dimensions were designed by Thyssen and Company at Mulheim-am-Ruhr, a few years ago. At present there is a plant of 100 tons per day through-put at Thyssen and Company's works, another at the Hamburg Gas Works, and the two units at the Prince Bismarck Colliery, shown in Figure 6 at the bottom of this page.

The iron drums of these retorts are built in one piece 78½ feet long by eight and one-half feet in diameter. The coal is fed into the rotating tube at one end and is carried through the length of the tube in two hours by means of helical screw lifters riveted to the drum, dropping at the other end in the form of semi-coke. The iron drum runs in a chamber which is fired with producer gas, the chamber being heavily lagged against heat losses. The distillation gases together with the tar vapors leave the drum at the same end as the semi-coke.

What It All Means

INTERNAL HEATING: In general, four heating media have been attempted in internally heated retorts—superheated steam, hot producer gas, hot coke-oven gas and hot flue gases. There seems little doubt that steam is the most suitable direct heat carrier because it can be separated from the products of distillation by suitable cooling, so that these products are obtained in an undiluted form. Such a process, however, gives little commercial promise and the operation is very expensive for complete tar recovery. It is not sufficient merely to cool the large amount of steam necessary to 100 degrees, Centigrade; the steam must be condensed to water to make the extraction of benzine possible. This involves further steam raising, a combination which even with good heat exchange means a large expenditure of fuel and cooling water. Owing to their improbability of commercial success, the several processes employing this method will not be described.

HOT PRODUCER GAS AS A HEATING MEDIUM: McLaurin in Scotland effects carbonization by means of hot generator gas instead of superheated steam, as shown in Figure 5.

The McLaurin retort is essentially a by-product recovery gas producer in which part of the semi-coke is burned to producer gas, the sensible heat of

which carbonizes the descending charge of coal. The experimental producer at Grangemouth, Scotland, is of square cross-section, about 45 feet high by eight feet wide at the widest part. The air-blast is introduced about 12 feet above the discharge doors, through a large number of narrow ports in opposite side-walls, and also by similar ports in a dividing wall which is carried across the center of the retort at the same level. The coke is cooled in the zone below the air port, steam being injected at the discharge doors. A part of this steam ascending through the coke becomes heated and partly decomposed into water gas, thence passing upward and mixing with the producer gas formed in the combustion zone. The raw coal is discharged from an elevated hopper through a bell into the top of a cylindrical steel tank eight feet in diameter by ten feet high, resting on the brick work at the top of the retort.

This tank serves as a condenser for the oils and tars which drain down the side of an inner steel cylinder which dips into the well formed by a dished flange at the bottom of the tank. From the annular space between the tank and the cylinder, the gases are led off to tower coolers and scrubbers. The plant is continuous in operation and a retort of the dimensions given will hold about 30 tons of coal. A 100-ton plant employing this process has recently been installed at the Dalmarnock Gas Works at Glasgow, Scotland.

HOT COKE-OVEN GAS AS A HEATING MEDIUM: In England, Sutcliffe and Evans blend coal, rich in gas, with lean or oxidized coals, briquetting the mixture at high pressure without the addition of a binder. By this means they are able to improve the physical structure of the coke which they then make from these briquettes. Through the hardness and strength thus obtained, they are able to put enormous tonnages into large perforated cylinders mounted axially in a vertical retort. Through this retort they circulate hot coal gas. This gas is continually reheated in two regenerators, one of which gives up its heat to the return gas while the other is being brought up to temperature again by the combustion of the surplus carbonization gas, with the usual arrangement for changing over.

CARBONIZATION BY MEANS OF FLUE (OR RE-RUN) GASES: Undoubtedly, the most interesting recent development to American operators is the announcement of the installation of a 200-ton McEwan-Runge commercial-scale experimental retort at the plant of the Milwaukee Electric Railway and Light Company. The operation of this plant is shown in Figure 7. It utilizes the principle of carbonization of pulverized coal in suspension by means of flue (or re-run) gases. The powdered coal is dropped into an internally heated tower where it comes in contact with an upward current of hot, inert gas. The extremely large surface of the finely divided coal particles insures a rapid transfer of heat so that distillation is effected during the time the fuel falls from the top to the bottom of the tower, a distance of about 30 feet.

What Its Advent Will Mean

When using coals having a tendency to agglomerate, advantage is taken of the fact that, by preheating the coal to an average temperature of 365 degrees, Centigrade, the coking tendencies of the particles are destroyed. It is then passed through another tower, immediately beneath the first one, where the balance of the volatile matter is distilled by passage through a counter-current flow of gas at an average temperature of 565 degrees, Centigrade. The gases and vapors are then carried off to the scrubbing and cleaning apparatus and the pulverized semi-coke is conveyed from the bottom, to be burned under boilers in pulverized form.

What, then, is the significance and the future of low-temperature carbonization? The reader will have observed from the previous discussion that the expenditure of 36 years of continuous scientific effort and many millions of dollars in research have resulted in developments which bring us today to the threshold of the commercial achievement of an important new method of serving society. With its advent, Europe will be less and less dependent, as at present, on overseas supplies of oil and motor fuels. America will regard with less dismay the fact that her domestic supply of oil, recoverable by present methods, if expended at the 1925 rate, will last but a decade. More and more will the smoke problem of our cities be solved to the benefit of the community's health, comfort and financial profit. A new and important source of land fertilization will contribute toward larger and better crops for the farmer.

How soon we will commence to feel this in a large way, one hesitates to predict. An auspicious start has been made. Engineers, scientists and financiers are redoubling their efforts to expedite its larger application. If the present rate of progress continues, another decade should see smokeless low-temperature coke, oils, gas and fertilizer widely available in Europe and in the larger American cities, particularly those of the middle west where coking coals must be hauled hundreds of miles, frequently on tracks laid immediately over enormous deposits of non-coking or weakly-coking middle-western coals.

Meanwhile, as in the history of other major engineering developments, wily promoters with inadequately conceived ideas will profit hugely to the detriment of the gullible public, while a few far-sighted financiers will ally themselves with competent engineers, and merit the enormous profits justly due successful pioneers.

The Colorado River, 260 miles from Los Angeles, is to supply the residents of that California city with water for domestic uses. An illustrated article in a future issue will tell of this unusual engineering feat.

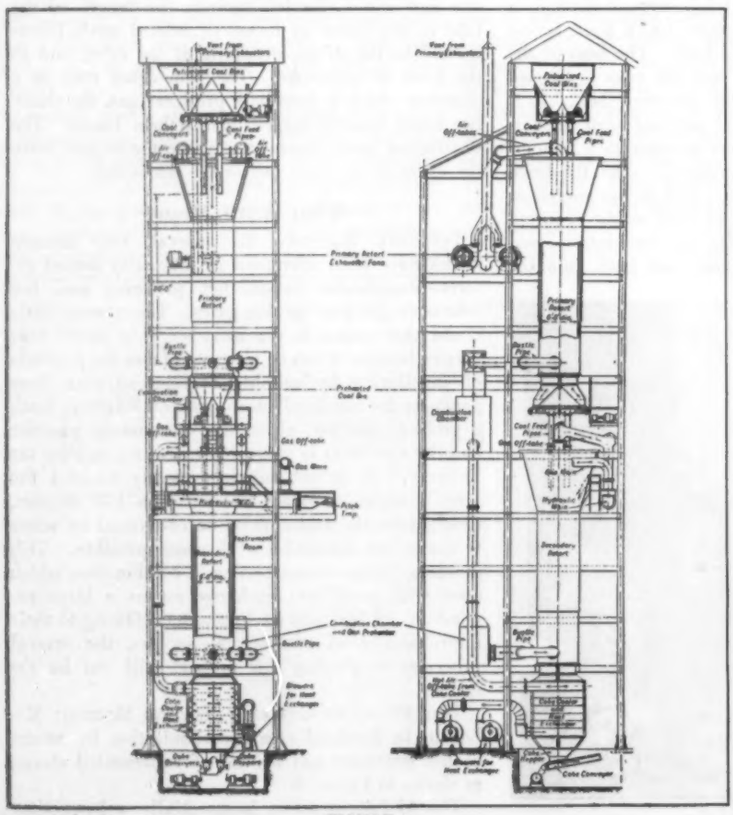


FIGURE 7

Quite recently the McEwan-Runge vertical, internally heated retort has been put into operation. It uses the coal in pulverized form and passes it through hot gases

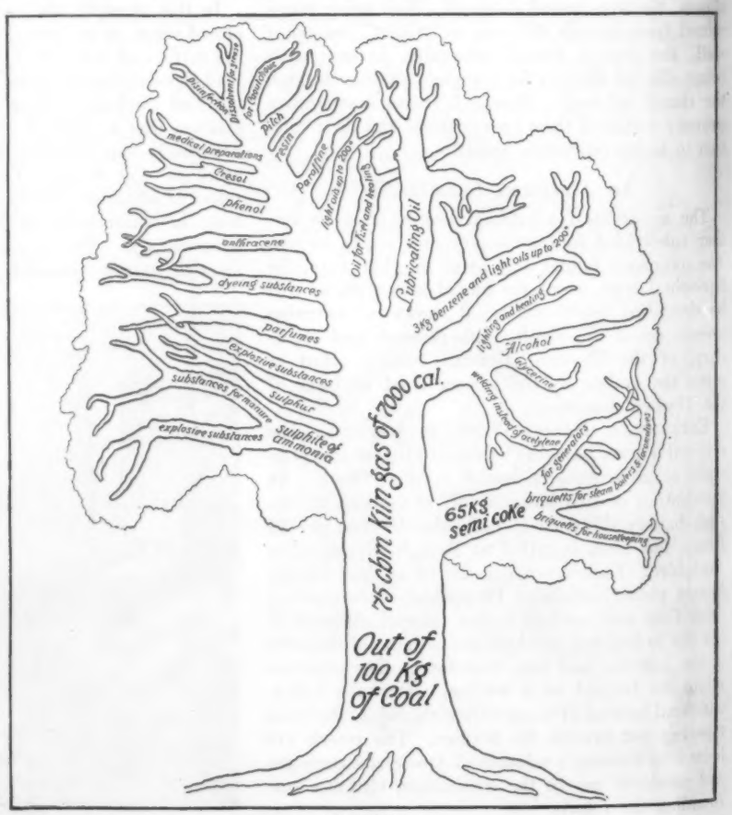


FIGURE 8

How the coal is split up into many products is shown by this carbonization "tree"—in this case, that of the Thyssen process. Some of the by-products are quite valuable

Inventors Who Have Achieved Commercial Success

The Second Interview of This Series Is With a Man Who Has Capitalized the Human Desire for Play

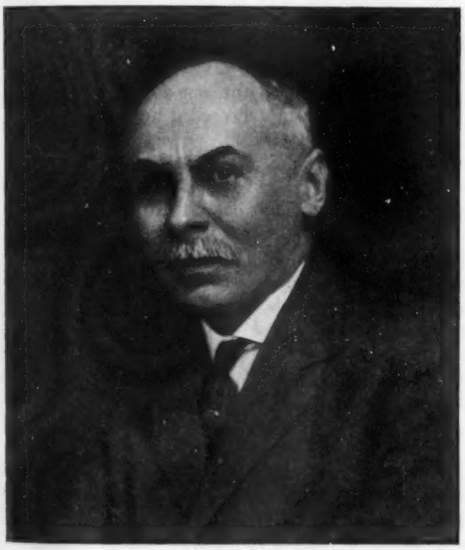
By Milton Wright

THE field of invention is limited only by the boundaries of human activity. Consider amusements, for example — such things as scenic railways and merry-go-rounds. Some inventor visioned thousands enjoying them and spent months of labor before ever a ride was taken. The story of an outstanding inventor in the amusement field should prove worth while.

Wherefore, we paid a visit to William F. Mangels, carousel manufacturer at Coney Island. Among the 50 or more novelties he has patented is one which became the most successful amusement device ever used at carnivals.

"How did you ever get started inventing things like these?" we asked him, pointing to roller coasters, merry-go-rounds and numerous other half-made things in his big factory.

"I just grew into it," he replied. "As a boy I



WILLIAM F. MANGELS

Knowing that all people like good fun, this inventor has perfected, and profited by, devices which provide that fun

worked in my father's machine shop. We made parts for carousels. When I grew up I opened a little machine shop of my own in one room. I had no capital, so I could use only hand tools. I did any jobs I could get. In my spare time I worked over an invention I had in mind. It was the 'Razzle-dazzle.' Remember anything about that? It had a fixed center pole with seats to swing around it. This was back in 1890."

"And you applied for a patent and then went out and sold your patent rights to a manufacturer?"

"I did nothing of the sort," he replied. "I got another man to risk 500 dollars with me and with that capital I made the first Razzle-dazzle. We set it up in county fairs, one after another, and we kept going until the fair season closed. When we finished at some place out in Indiana we had enough money accumulated to build several more for the next season. The first one was operated by two men pulling on ropes. After that we used steam engines.

"Here is a copy of that first patent. Look at the number—452,227. Here is my latest patent, just a few weeks old. This number, you see, is 1,603,284. There certainly have been a lot of patents issued since I got my first one in 1891."

"How many of those patents have been yours?"

"Fifty or sixty. I get one or two every year. Some of them have done pretty well, others not so well. If a man goes in for inventing, he cannot expect to 'ring the bell' every time. You might have nine patents that fail to really take and then make a hit with the tenth; the tenth will more than pay you for the time and money you have spent on the nine.

"My experience has been similar to that. After the Razzle-dazzle I ran along without having any of my inventions make any particular success until 1907. In that year I brought out the 'Tickler.' That was an inclined plane with round cars sliding down. The cars would bump against short posts and get whirled this way and that.

"I showed a wash drawing of the Tickler to Frederick W. Thompson, owner of Luna Park, and asked him if he could give me space to install it.

"'Mangels,' he said, 'You will need barrels to take your money away in.' He was pretty nearly right. It cost 6,000 dollars to install the Tickler and the first season's receipts were 42,000 dollars. The same rate of profit kept coming in from Luna Park for several years. I took in a partner and we branched out. We made Ticklers for amusement parks everywhere."

"Did you manage all of these yourself?"

"No. We sold limited territorial rights. Rights for Atlantic City, Philadelphia, Chicago and Canada were especially valuable. Royalties from users amounted to 35,000 or 40,000 dollars and in addition all the equipment was manufactured at our shop."

$300,000 Royalties on One Device

"Not many Ticklers are seen now."

"No. The novelty wore off in time. We kept putting out one or two new inventions a year with only moderate success until 1914. Then came the 'Whip'—the biggest hit of them all. We tried it out first in Luna Park and it spread all over the world. We have made more than 500 Whips—every one of them paying a royalty. These royalties have totaled over 300,000 dollars. We have sold the rights in Great Britain, Germany, France, Spain, Italy, Cuba, South Africa—every place where there are civilized people who like to play. And remember we make the apparatus, too. We shipped one to South Africa. It cost the showman over 14,000 dollars before he set it up, but it paid for itself in six weeks.

"You know what the Whip is like—a little car running around on an elliptical track with an extra snap given to the motion as the car goes around the ends. The beautiful thing about the Whip is that it has lasting qualities; it is going as strong now as it did 12 years ago. Along with the Ferris Wheel and the Merry-go-round it has become one of the standard, never-failing attractions of every carnival."

"But the Whip being such a success, haven't you had trouble with infringement suits?"

"We might have had if our patent claims had not been drawn as carefully and skilfully as they were. The Whip ran ten years unchallenged and then another firm put out a similar device. You will recall that when you ride in a car on the Whip there is a sudden extra swerve or jerk as the car rounds the bend, but you do not turn completely around. This new device did. Fortunately, our patent claims covered that complete turning around, although our car does not actually do it. We made a license agreement with the other firm. Last year they paid me 1,000 dollars royalty on each of 43 pieces of apparatus they made."

"You could have retired on the proceeds of that invention, couldn't you?"

"How could I retire? A man must keep busy and I know nothing more interesting than working out some new idea and seeing it go over or seeing it flop, as was the case with a new ride I invented last year. We spent 6,000 dollars constructing the device. It looked great on paper. Then we tried it out privately for two weeks and scrapped it."

"What was the matter?"

"Too slow. The public wants speed."

"What do you consider the tendency in amusement devices today?"

"Apparatus for children. In all the big amusement parks they are putting in 'Kiddie Parks' where all the grown-up sized apparatus is reproduced on a small scale—children's Ferris Wheels, children's Scenic Railways, children's Whips, children's Merry-go-rounds with tiny horses, children's Airplane Swings and so on.

"Look at this miniature railroad I am going to bring out next summer. Small and safe but it gives the youngsters a thrill. Look at the little engine up front that pulls the five cars—built like a hand car. We will put two funny little figures on that and they will pump up and down as if they were making the train go. Can't you just hear little Willie shouting in glee as he rides around, while papa and mamma stand on the side and glow with pride and happiness?"

At one time, a good shipping container for chemicals and foods was needed. An inventor saw the need, studied the situation and set about to design a container that would be satisfactory. The story of his success will be the subject of the next article of this series.

THE CHILDREN'S "WHIP"

Pleasure rides designed especially for the kiddies are becoming more and more popular in large amusement parks

A RADIO-TRANSMITTED PHOTOGRAPH

This photograph was transmitted by means of the modulated-signal method. Four minutes were required for the actual radio transmission

Radio's Silver Screen

Cluster of Seven Lights Carries Inventor Toward the Goal of Wireless Vision

By Orrin E. Dunlap, Jr.

GEORGE BERNARD SHAW in his play "Back to Methuselah" describes a scene portrayed as a reality in the year 2170. He foresees the head of the British Government holding conferences with his cabinet ministers several hundred miles distant. Near the king's desk is a switchboard and on the wall of the room is a silver screen. When a certain key is pressed on the panel of the control board a life-sized image of the person with whom he is speaking appears on the screen simultaneous with the reception of his voice.

Today it requires about 20 minutes to flash one picture across the Atlantic. However, the imagination of Bernard Shaw predicts a direct vision of moving objects as seen in a cinema theatre. The science of motion pictures teaches research men that they must project a series of pictures through space at the rate of 16 a second if the forecast of the English author is to be more than merely an optimistic dream.

"It is a long way from 20 minutes to one-sixteenth of a second," said Dr. E. F. W. Alexanderson, television research engineer, before a meeting of the American Institute of Electrical Engineers in St. Louis. He then revealed to the surprise of many in radio circles that he has tackled the problem from a new angle and, based upon his discoveries, he told of the prospects of practical television and how far engineers have progressed toward the ultimate goal painted in words by Bernard Shaw.

It seems that the basic principle of picture transmission over wires or through the air was introduced 50 years ago and all work done at the present time hinges on the same idea, which fell into neglect only to have the development of broadcasting renew interest in the subject. Today there are new tools to work with, such as the oscillograph, vacuum tubes and the photo-electric cell, known as the "eye" of radio. Through these agencies, radio photography has become an established fact. However, a practical television system, or the science of seeing moving objects and distant scenes by radio, involves some obstacles, which have heretofore seemed almost insurmountable, but upon which a new light is now being cast, according to Dr. Alexanderson.

"Radio has up to the present developed two distinct methods of signaling: by modulation and by interruption," said Dr. Alexanderson. "The first is usually associated with broadcasting and the second with wireless telegraphy. Both of these systems may be adapted to radio photography and each will have a distinct field. The effective range of a broadcasting station is much shorter than a code transmitter of the same power, but within this range the broadcaster gives a service of excellent quality. Pictures have been made with a modulation frequency of 3,000 cycles which can be transmitted easily by the ordinary broadcasting station. It is therefore possible that a picture service may be given by these same stations, which will be of the same standard of quality as the musical programs. Freedom from disturbances is insured by having a large number of stations interlinked by a wire system so that a good selection of entertainment is available in all parts of the country. This method of dealing with static and fading may be characterized as brute force, but it is this mode of operation that has developed broadcasting into a great industry. The entire broadcasting machinery is now available should the public become interested in radio photography for entertainment or otherwise."

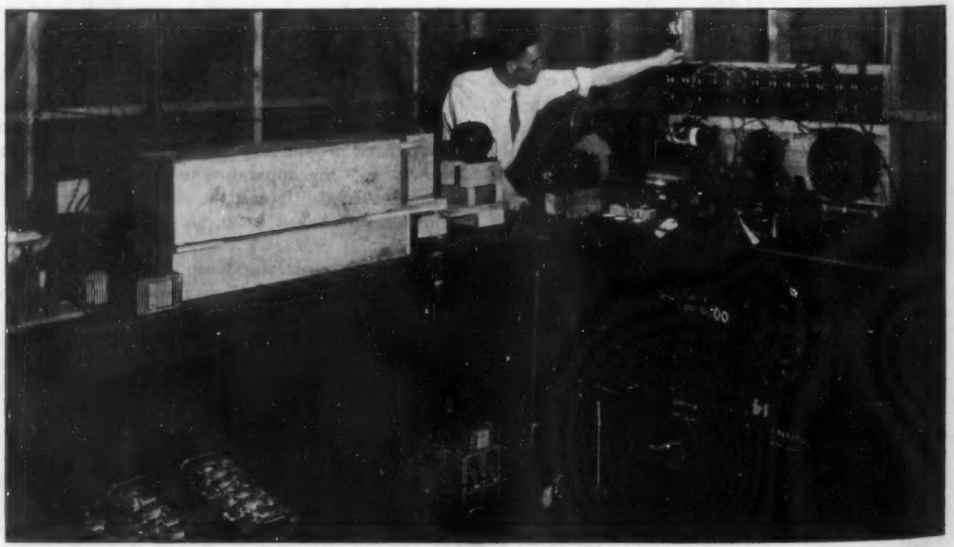
The "Brush" That Paints the Picture

In Dr. Alexanderson's research work in the television field he has looked upon the adaptation of the telegraphic method of communication to picture transmission as one of the essential problems and a system has been developed for sending half-tone pictures in a manner which takes advantage of the more efficient methods used in modern radio telegraphy. The underlying principle which makes this possible is the utilization of a signaling system in which the results are independent of the signal intensity. If the signal is strong enough to register, it gives the same kind of records at the maximum as at the minimum signal intensity. This makes the recording independent of fading. Furthermore, if the incoming impulses are stronger than the prevailing static, it is possible to eliminate the effects of the atmospherics by introducing a threshold value of signal strength in the receiver so that nothing is detected unless the signal exceeds this value. Methods of this sort all have an important bearing on the ultimate success of television.

Dr. Alexanderson explained that the half-tone effects in his system are produced by dividing the picture in five or more separate shades, such as white, light gray, medium gray, dark gray and black. The transmitting and receiving machines analyze and reassemble these shades automatically. Various methods may be perfected for translating light intensities into Hertzian waves. One method would be to use five wavelengths, one for each shade; but Dr. Alexanderson has succeeded by a process utilizing a single wave.

The transmitter at Schenectady is built in such a way that at every moment it automatically selects the shade that comes nearest to one of the five shades, and sends out a telegraphic signal which selects the corresponding shade in the receiving circuit. The telegraphic code by which different shades are selected depends upon the synchronization of the two machines and this is necessary under all circumstances. Thus, black in the picture is produced by the exposure of the sensitive paper to the recording light spot during four successive revolutions, whereas light gray is produced by a single exposure during one of the four revolutions and no exposure for the three succeeding revolutions. The overlapping exposure is progressive and the whole operates as a continuous process.

"When we embark on such an ambitious program

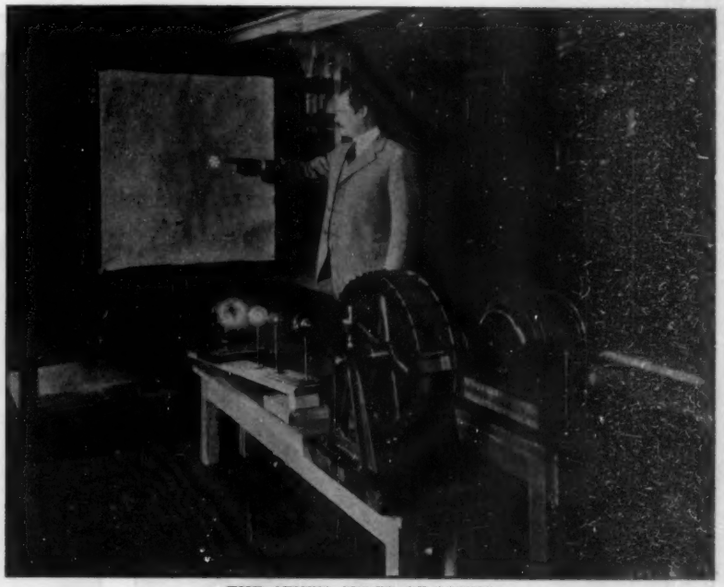


THE TRANSMISSION APPARATUS USED BY ALEXANDERSON

The principle of picture transmission was discovered 50 years ago but was neglected until radio and its associated electrical tools revived interest in sending illustrations through space. Note the film on the revolving drum

PICTURE-RECEIVING APPARATUS

The film on which the picture is "painted" by a stream of light is placed upon a cylinder which revolves in synchronism with a drum at the transmitter



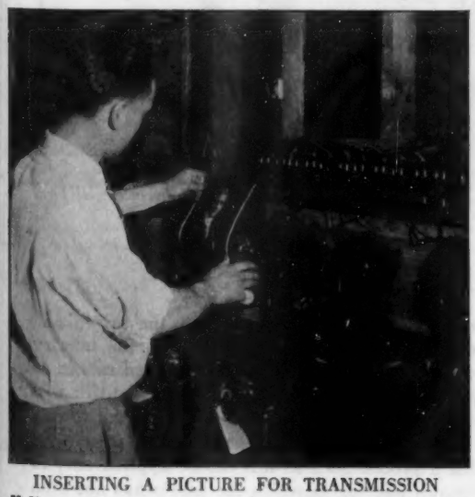
THE SEVEN SPOTS OF LIGHT

This cluster of lights forms the basis of the new system, developed by Dr. E. F. W. Alexanderson, for sending pictures of moving objects through space by radio

as television," said Dr. Alexanderson, "we are dealing with the photo-electric cell, the amplifier, the antenna and the radio wave. The photo-electric cell and the vacuum-tube amplifier employ the medium of the electron, which is extremely fast, but the radio wave imposes certain speed limitations on account of the limited scale of available channels. The question therefore remains: what quality of reproduction may we ultimately expect in television if we succeed in taking full advantage of the ultimate working speed of the radio wave?"

Bernard Shaw's specification has one outstanding requirement in that he wants the television picture shown in life size on a screen. That introduces a fundamental difficulty. When the receiving drum is stationary, a spot of light is focused on the screen. This spot of light is the brush that paints the radio picture. When the drum revolves, the spot of light passes across the screen. Then, as a new mirror, which is set at a slightly different angle, comes into line, the light spot passes over the screen again on a track adjacent to the first and so on until the whole screen is covered. It requires at least 10,000 strokes of this "brush" if a picture of fair quality is to be obtained. This may mean that the spot of light should pass over the screen in 100 parallel paths and that it should be capable of making 100 separate impressions of light and darkness in each path. If this process of painting the picture is repeated over and over again 16 times in a second, it means that 160,000 independent strokes of the brush of light are required in one second. To work at such a speed seems inconceivable; moreover, a good picture requires a scanning process with *more* than 100 lines. This brings the speed requirements up to approximately 300,000 picture units a second.

Aside from the theoretical possibility of employing waves capable of high-speed signaling, Dr. Alexanderson calls attention to the fact that the televisor must have a light of such brilliancy that it will illuminate the screen effectively, although the light beam stays in one spot only one three-hundred-thousandths of a second. This has been one of the serious difficulties because, even if the most brilliant arc light is used, and no matter how the optical system is designed, engineers cannot calculate sufficient brilliancy to illuminate a large screen with a single spot of light. A model television projector has been built at the Schenectady laboratory in order to study this problem and to demonstrate the practicability of a new system which promises to give a solution to this puzzle.



INSERTING A PICTURE FOR TRANSMISSION

Half-tone effects are produced by dividing the picture into five or more separate shades such as white, light gray, medium gray, dark gray and black. The transmitter and receiver select these shades automatically

Requires 300,000 Picture Units a Second

"If we employ seven spots of light instead of one," said Dr. Alexanderson, "we will get 49 times as much useful illumination. Offhand it is not easy to comprehend why we gain in light by the square of the number of light spots used. However, the drum has 24 mirrors and in one revolution of the drum one light spot passes over the screen 24 times; and when we use seven sources of light and seven light spots we have a total of 168 light-spot passages over the screen in one revolution of the drum.

"It is easy to design a television system with something like 40,000 picture units per second, but the images obtained are so crude that they would have little practical value. Our work on radio photography has revealed that an operating speed of 300,000 picture units per second is needed to give pleasing results in television. This speeding-up process is unfortunately one of those cases where the difficulties increase by the square of the speed, and the root of the difficulty is that we have to depend upon moving mechanical parts.

"If we knew of any way of sweeping a ray of light back and forth without the use of mechanical motion, the answer might be different. Perhaps some such way will be discovered, but we are not willing to wait for a discovery that may never come. Fortunately, we have found out that seven television carrier-waves may be spaced 100 kilocycles apart and a complete television wave band must be 700 kilocycles wide. Such a channel might occupy the waves between 20 and 21 meters. If the use of this wave band will enable us to see across the ocean, I think all will agree that this space in the ether is assigned for a worthy purpose.

"How long it will take to obtain this end I do not venture to say," said Dr. Alexanderson. "Our work has, however, proved that the expectation of television is not unreasonable and that it may be accomplished with means that are in our possession today."

Apparently not satisfied with being the one to first make long-distance radio transmission possible, Marconi has made an enormous step forward in the development of "beam" or directional radio-transmission. Details on this will appear in our March issue.

WHEN THE ETHER PLAYS TRICKS

The distortion in this radio-transmitted picture is caused by improper adjustment of the receiving instruments. It gives a visual idea of the audible distortion often experienced when receiving music and speech

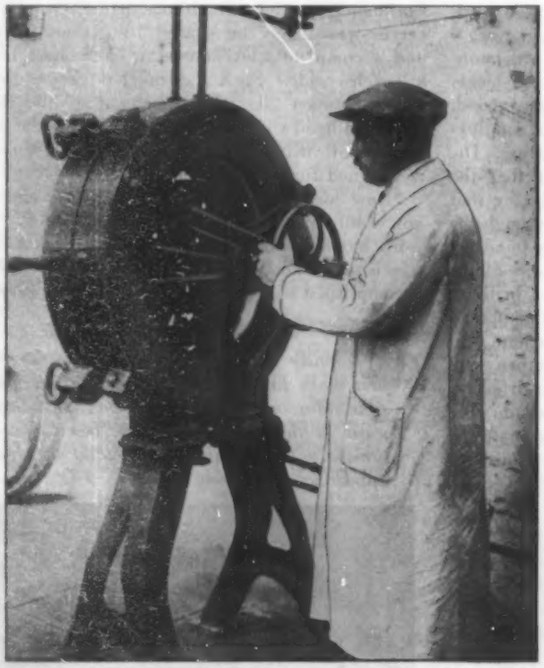
All photographs by P. & A. Photos

APPLYING THE NEW RUBBER STRIP

After the surface of the old tire has been prepared, this strip is cemented and vulcanized in place and a new tread is formed

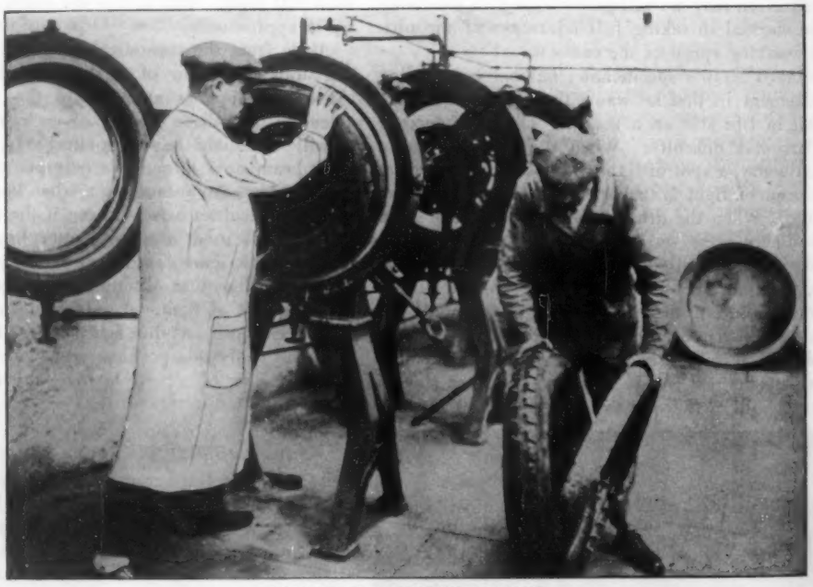
COMPRESSING THE NEW STRIP

With this special machine, a rolling action forms perfect contact between the new rubber coating and the prepared, gummed surface of the old tire. The spring keeps the tension constant



WHERE THE TIRES ARE VULCANIZED

The design of this machine is such that the entire surface of the tire receives a constant pressure during the vulcanizing process



ONE OF THE FINISHED TIRES

Before the tire is placed in one of the machines shown at the left, it is surrounded by a special form that molds a new tread in the surface. This is said to be unusually long wearing

Tire Rejuvenation System Makes Old Tires New

When we consider the thousands of automobile tires that are thrown away because of worn surfaces and before the body or fabric is damaged, it will be seen at once that any method that will reclaim these tires, and do this in an economical manner, should be well received. The latest report of a system of this kind comes to us from France. First the surface of the old tire is scraped clean and all of the worn material removed. Then it is coated with a gummy preparation, said to be secret in composition, and a new strip of rubber laid on. The tire is next placed in a device that thoroughly compresses the strip to the tire. The secret compound causes them to adhere firmly. A metal rim, bearing the design of the tire tread, is placed around the tire and the whole is inserted in the vulcanizing machine. Special pressure devices exert an even force from the interior of the tire carcass and heat quickly vulcanizes the newly placed rubber to the old tire. When the process is completed, it is said that the tire will have a life 75 percent as long as it had originally and that the entire cost of the rejuvenation will be only 25 percent of the purchase price. Of course, it seems obvious that a process such as this can be applied only to tires that have not been "blown out" or in which the fabric has not been injured. In these it would be necessary to repair the fabric as well as the tread, work that is not always satisfactory in result.

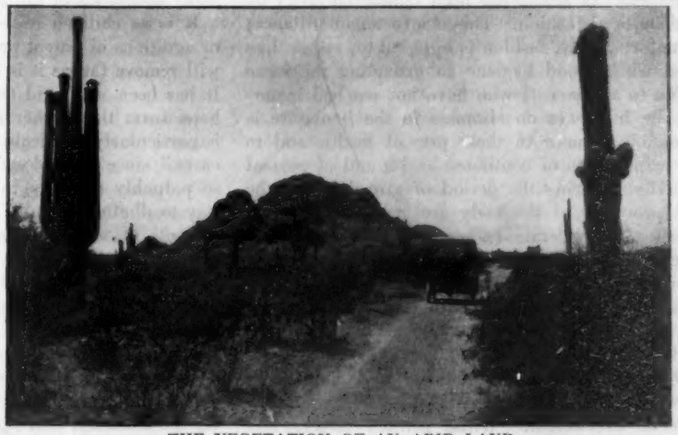
All photographs and text furnished by C. F. Talman of the United States Weather Bureau

A FAMILIAR INDEX OF CLIMATE—THE SNOW-LINE

Temperature, precipitation and evaporation control the height of the snow-line. The "temporary" snow-line, here seen on the Portneuf Mountains of Idaho, varies with season and weather, and is generally lower than the "climatic" snow-line, which marks the lower limit of perpetual snow

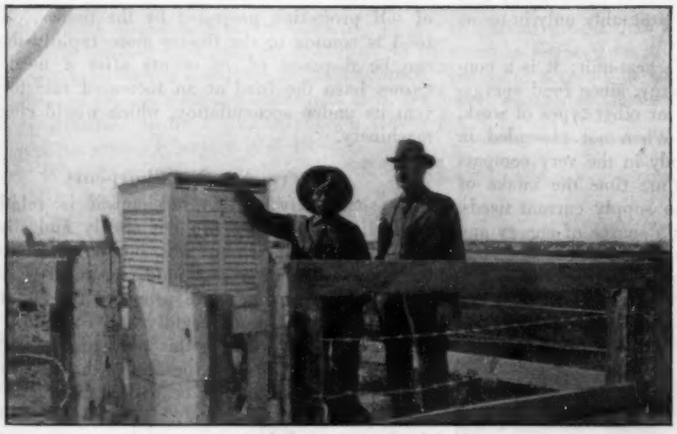
THE SNOWFALL ON MOUNT RAINIER

The windward slopes of the Sierra Nevada and the Cascade Range, lying athwart the prevailing oceanic winds, are the mightiest snow-makers found in this country



THE VEGETATION OF AN ARID LAND

Giant cactus and mesquite in southern Arizona. The leafless cactus offers a minimum evaporating surface; the mesquite, with its long roots, taps water far underground



THE ACME OF SUMMER HEAT

Death Valley, California, has the hottest summer weather in the United States and is also unrivaled for aridity. The temperature has reached 134 degrees, Fahrenheit

ARCHITECTURAL RESPONSE TO CLIMATE

The pueblo of Acoma, New Mexico. The flat roofs denote a light rainfall; the thick adobe walls maintain an equable temperature indoors with a wide range outside

Pictures of American Climate

According to the familiar epigram, the northeastern part of our country has weather, but no climate. This means merely that the underlying climatic features of the region are masked by incessant cyclonic disturbances. In the west, where such disturbances are less common, climate prevails over weather. Each of the above western scenes embodies a little lesson in climatology. At the top of the page we have a well-defined example of the snow-line on mountains; a favorite climatic index with the geographers ever since the days of Humboldt. Below, to the left, is an illustration of the heavy snows that fall on a lofty slope facing the prevailing winds from an adjacent ocean. On the south flank of Mount Rainier more than 65 feet of snow has fallen in a winter, and farther west on the same mountain the snowfall is believed to be even greater. To the right we see how vegetation has been evolved to fit an arid climate. The terrific heat of Death Valley may be in part a "foehn" effect. The valley is below sea level and the mountain ranges west of it lie athwart the prevailing winds. Acoma, on a lofty plateau, has a dry, sunny climate, with wide ranges of temperature, and its architecture is planned so as to furnish a maximum of comfort to the inhabitants.

The Straight and Narrow Path to Normal Weight

Pitfalls Menace and Pseudo Short-cuts Beckon the Feet of Those Who Seek Easy Methods of Reducing Their Weight

By H. H. Mitchell

Professor of Animal Nutrition, College of Agriculture, University of Illinois

"Any method of fat reduction that professes to avoid diet or exercise must be a fake,"—so says the author of the accompanying article. "Don't be fat," say many advertisements which recommend anti-fat remedies that radically reduce weight. Just as claimed, these remedies *do* reduce one's weight, but so would lots of other medicaments that are injurious or near-poisonous; borax, for example. One way to reduce is to exercise, says the author, but the best as well as the hardest is not to eat so much. ***The Editor.***

THE emphatic statements of medical authorities to the effect that overweight in persons beyond 40 years of age is a distinct handicap to the maintenance of health has been reinforced lately by the dictates of fashion. This is a fortunate alliance; but unfortunately, fashion is opposed to, rather than allied with, sound hygiene in extending the same dictum to adolescents who have not reached maturity. Its insistence on slimness in the immature is a possible menace to their present health and to their expectation of continued health and of normal longevity. During the period of growth, when the vital processes of the body are at their maximum intensity, a moderate excess of fat is a sensible margin of safety against emergencies, but when maturity is reached and passed and the vital processes are being toned down with advancing age, even a moderate excess of fat may become a troublesome burden.

The contrast between maturity and immaturity covers conditions of underweight as well as conditions of overweight. While marked underweight cannot be said to be an hygienic asset at any age, it is a more serious symptom in youth than in middle age. Even a moderate degree of underweight is considered disadvantageous in children, while in middle life it may reasonably be considered an asset unless accompanied by obvious symtoms of disease or malnutrition.

Obesity May Be Hereditary

Subnormal weight, if not a symptom of chronic disease or if not of an hereditary character, is a sign of malnutrition, involving either an improper balancing of the diet or an insufficient consumption of food, or possibly both. Its correction is a relatively simple matter when the type of malnutrition has been determined, but a general discussion of the subject is inadvisable, in a short article, since each case is an individual problem not to be solved by following a few general precepts. This article is directed at the problem of overweight, and in particular, overweight in middle age, since in youth and early maturity it does not present a serious situation.

At the outset, it seems necessary to emphasize an unfortunate, but none-the-less real, characteristic of the job of correcting overweight or, in other words, of fat reduction. It is a serious job not to be lightly undertaken and not to be pursued profitably in a dilatory or spasmodic fashion. It takes no great amount of thought to realize that weight reduction relates primarily to a regulation of diet or to a regulation of muscular activity, or to both. Excess flesh is stored food representing food consumed in amounts above current expenditures; muscular exercise is the most effective method of expending food and consequently of diminishing food stored as surplus flesh. Therefore, any method of fat reduction that professes to avoid dieting or exercise must be a fake. It is a sad commentary upon human intelligence that many reducing methods of this description are widely patronized to the tune of many thousands of dollars.

It is as childish to believe that pills, ointments, or additions of patent preparations to the bath water will remove fat, as it is to believe in a Santa Claus. It has been well said that ignorance and credulous hope form the market for patent medicines. This is particularly applicable to the market for "obesity cures," since their descriptive advertising matter is so palpably contrary to common sense. The only way to diminish a bank balance is to diminish your deposits of money or to increase your current expenses, and the same is true of the balance of flesh in the body. Other expedients, like "the flowers that bloom in the spring," have "nothing to do with the case."

Under-nutrition, as has already been observed, may be due to an improper balancing of the diet as well as to an insufficient consumption of food. On the contrary, over-nutrition is the result only of an over-supply of food with reference to the requirements. It is a quantity problem entirely. It is concerned with the body's disposal of food energy and therefore it can be discussed profitably only in terms of food calories.

A calorie is the physicist's heat-unit; it is a convenient measure of food energy, since food energy, when expended in muscular or other types of work, leaves the body as heat. When not expended in work, it is stored by the body in the very compact form of fat. If at any future time the intake of food energy is insufficient to supply current needs, this deposited fat is used as a source of energy and is ultimately converted into heat.

Courtesy Metropolitan Life Insurance Company

EXERCISES NOW BROADCAST

Morning exercises, of some benefit to those trying to reduce, can be accompanied by instructions via radio

One of the most obvious facts about obesity is that it appears to be more or less the result of hereditary influences. The members of some families almost invariably become fat in middle age, apparently regardless of their dietary habits or of the nature of their daily activities. The members of other families as persistently remain lean and spare. There may be two factors involved in this puzzling situation.

It is known that the vital activities of different individuals may be pitched at different levels of intensity, so that different persons of the same size may produce different amounts of heat when at complete rest in bed. Obviously those producing the smallest amounts of heat will store more fat on a given excessive intake of food than those with the highest "basal heat production." In other words, other things being equal, they would show a greater tendency to fatten.

Another difference between individuals that has a bearing on the same question relates to the heating effect of food. When food is consumed, the production of "animal heat" is increased, in a manner quite analogous to the increased heat output of a furnace fire when coal is thrown upon it. This heating effect of food may be thought of as a means of self protection possessed by the tissues. When food is coming to the tissues more rapidly than it can be disposed of, as occurs after a meal, the tissues burn the food at an increased rate to prevent its undue accumulation, which would clog the machinery.

There Are No Short-cuts

In some persons this mechanism is relatively ineffective, the tissues are but slowly and slightly excited to an increased heat output after eating, and practically all excess food consumed is stored as fat. These persons are prone to fatness unless their dietary habits are rigidly and constantly curtailed. In other persons this mechanism is active, so that normally 10 or 12 percent of the food energy consumed is dissipated as heat in this way. In still other persons the mechanism is so active that all food consumed in excess of the requirements is burned up, preventing any considerable deposition of fat. These persons are the "constitutionally lean," in whom overweight cannot be induced by over-feeding. While the problem of the "why" and the "wherefor" of obesity cannot yet be said to be solved, in all probability a sluggish response of the tissues to the stimulating effect of food, acquired through heredity, is a factor of considerable importance.

Granted that all effective methods of weight reduction must include dieting or exercising or both, it is important to inquire which of these two procedures is the most effective. Dieting is undoubtedly the most *direct* method of reducing weight, since if the intake of food energy is lowered below the current energy requirements of the body, the

PART OF THE DIETETIC FOOD LIST USED BY A LARGE CHAIN OF RESTAURANTS

Name of Dish	Avoirdupois Weight	Protein Calories	Fat Calories	Carbohydrate Calories	Total Calories
Oatmeal	8 ounces	34	32	134	200
Wheat Cakes	5½ "	42	75	183	300
White Bread	3 "	21	9	120	150
Rye Bread	2 "	16	9	125	150
Tomato Soup	8 "	20	138	102	260
Broiled Mackerel	6 "	102	88	...	190
Oyster Stew	10 "	45	145	60	250
Two Boiled Eggs	3 "	54	96	...	150
Two Fried Eggs	3 "	54	136	...	190
Broiled Lamb Chop	1½ "	40	110	...	150
Baked Beans	8 "	64	48	183	295
Fresh Country Sausage	4 "	60	234	6	300
Pot Roast of Beef with Mashed Potatoes	8 "	150	234	65	450
Asparagus—Creamed	5 "	16	72	37	125
Green Peas—Creamed	5 "	35	121	114	270
Onions—Creamed	5 "	17	75	118	210
Baked Potatoes	4 "	11	1	88	100
Mashed Potatoes	6 "	20	20	160	200
Cold Roast Beef with Potato Salad	5 "	52	190	58	300
Swiss Cheese Sandwich	3 "	40	178	82	300
Chocolate Layer Cake	4 "	20	164	316	500
Creamed Tapioca Pudding	3 "	18	42	90	150
Strawberry Shortcake with Whipped Cream	7 "	13	237	200	450
Apple Pie	5½ "	11	139	250	400
Doughnuts	3 "	24	180	196	400
Hot Chocolate with Whipped Cream	9 "	22	191	97	310
Cup of Coffee	8 "	10	75	15	100
Glass of Milk	10 "	38	104	58	200

deficit *must* be made up from energy stored as fat.

It also appears to be true that dieting is more effective than moderate exercise in reducing adipose tissue. This conclusion is based upon the small energy expenditure resulting from moderate types of exercise, as compared with the energy contained in small portions of food. For example, the energy (about 113 calories) expended by a person of average weight in walking two miles may be derived from one-half of a large doughnut, or from one ice-cream cone, or from four soda crackers, or from 20 peanut kernels. A man of average weight will expend about 80 calories in climbing to the top of the Washington monument. If, after completing this considerable bit of exercise, he consumes less than one-half of an ordinary ham sandwich, or five large olives, or less than two chocolate caramels, he has completely replenished his body. An ordinary bar of milk chocolate contains sufficient energy to provide for three or four such excursions.

Since weight reduction is perhaps of more moment to middle-aged women than to middle-aged men, the following illustrations are significant: Light housework, such as sewing, requires 5 to 10 calories per hour, or 40 to 80 calories per eight hours. A moderate amount of candy—for example, three to six marshmallows—will supply this amount of energy. A bottle of ginger ale would provide enough energy for two full days of such average activity. Heavy housework, such as scrubbing and sweeping, occasions expenditures of 30 to as high as 50 calories per hour, or 240 to 400 calories for a full day of eight hours. Even so, one ice-cream soda, or at most a nut sundae, would provide the body with an equal number of calories. A heaping spoonful of sugar contains 30 to 40 calories, the equivalent of an hour's housework of a fairly heavy character.

It must be evident from these illustrations that a considerable amount of physical exercise, partaking of the nature of hard work, must be undertaken in order to offset the fattening influence of even small amounts of food, not ordinarily considered as important contributions to the day's bill of fare. Five or ten minutes of "setting-up" exercises, or daily walks of a few miles, even when religiously followed, cannot be counted as potent factors in the job of reducing excess weight, no matter how valuable they may be from other standpoints, as indeed they are.

Heavier work or more strenuous exercise, equivalent to large expenditures of energy, may defeat its own purpose by stimulating the appetite, a fat person's worst enemy. It is a matter of common observation that muscular work is a very potent appetizer, demanding, as it were, an increased intake of food to care for its increased expenditure of energy. As a fat reducer, therefore, really strenuous exercise, while effective, will tax the will power in two ways, not only in the conscientious undertaking of it in a routine way, but also in denying rigorously the demands of an increased appetite.

The outcome of the apparently well established considerations already discussed is that dieting is not only the most direct, but also the most effective method of fat reduction. It will do the job alone, if conscientiously and intelligently followed, with the least tax upon the will power. Restricting the diet, for example, by eliminating potatoes, would seem to be a much more sensible step in the path to normal weight than eating the potatoes and then working strenuously to burn them up. The elimination of a pound of boiled potatoes from the day's diet, containing some 400 calories, would be as effective in this respect as eight hours of strenuous housework, a walk of seven miles at moderate speed, climbing a steep hill with a gradient of over 30 percent for a distance of one-half mile, or some 13 minutes of the most strenuous exercise that a trained athlete can perform (competitive rowing).

Much might be written of the most advisable ways in which to restrict the diet, so that the intake of food calories is appreciably below the expenditure, thus necessitating the oxidation of body fat. However, a few general precepts may be sufficient. Much may be accomplished by denying oneself all confections and other between-meal refreshments. It has been estimated that on an average approximately 10 percent of the day's food calories are taken away from the table by the American public. A partial substitution of bulky, watery foods for concentrated starchy foods such as potatoes, bread and pastries, will tend to satisfy the appetite with a considerably smaller intake of calories. Many fresh vegetables and fruits can be used to advantage in this way, particularly cabbage, lettuce, celery, beets, cauliflower, spinach, tomatoes, turnips, asparagus, green beans, apples, berries, oranges and melons. Fat meats should be taboo, but lean meats need not be eliminated from the bill of fare, since protein, of which they are largely composed, is one of the most powerful stimulants of animal tissues. For this reason a considerable fraction of the calories contained in lean meats will of necessity be eliminated from the body as heat.

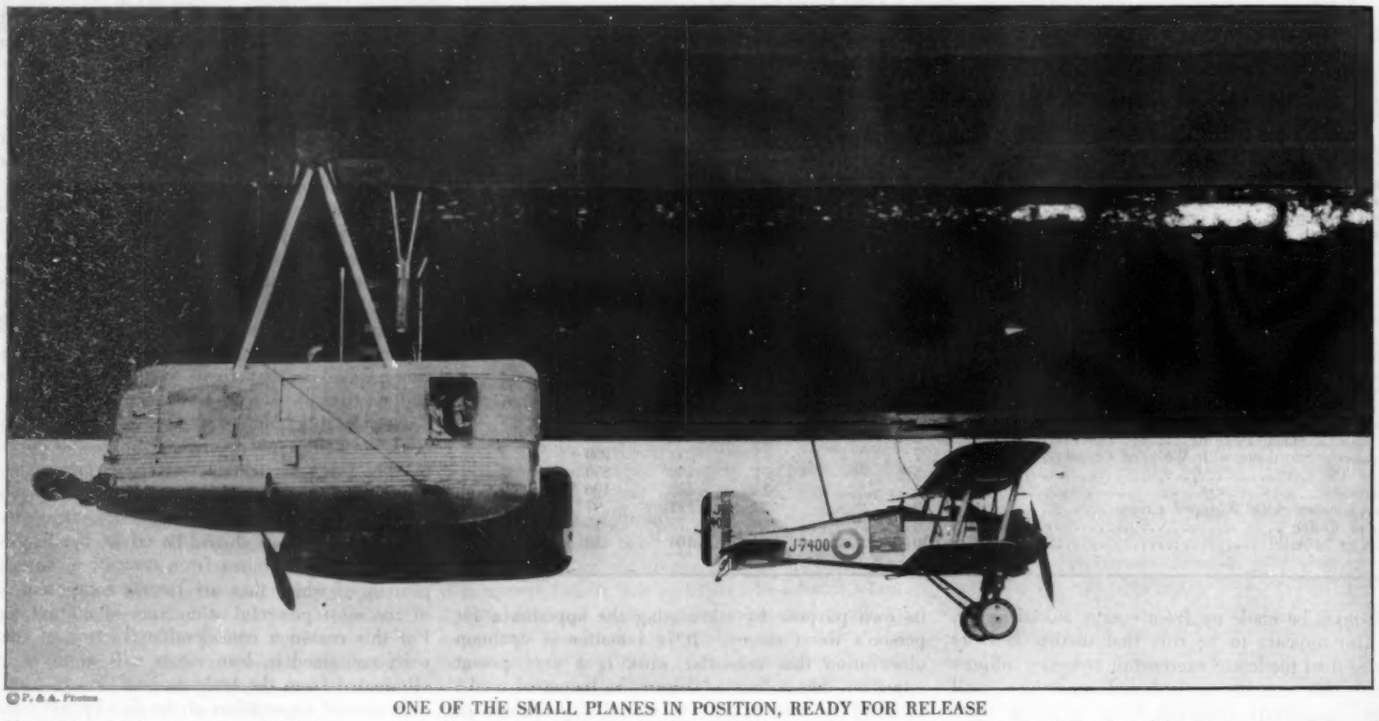
A careful supervision of the diet by weighing the food and comparing its computed calorie content with the estimated calorie needs of the body is quite unnecessary. A sufficient indication of the amount of dietary restriction necessary as well as of its success is afforded by taking body weights daily on reliable scales.

The path to normal weight for one "constitutionally" fat is truly a straight and narrow one. No short cuts can be taken, the blandishments of advertised obesity cures to the contrary notwithstanding. However, the satisfaction derived from a measurable, even though slow, progress toward the coveted goal should be sufficient compensation for the discomfort suffered. If feats of will power are excellent measures of self discipline, the reduction of a burdensome overweight has psychological as well as hygienic arguments in its favor.

THE AMOUNTS OF DIFFERENT FOODS THAT ARE EQUIVALENT IN CALORIES TO VARIOUS FORMS OF WORK AND EXERCISE, TAKEN FROM THE PUBLISHED EXPERIMENTS OF A NUMBER OF INVESTIGATORS

Form of Work or Exercise	Heat Produced	Amounts of Foods Containing an Equal Calorie Value: Sugar tsp.[1]	Boiled Potatoes Ounce	White Bread Ounce	Whole Milk Cups
Walking at the rate of:					
2.6 miles per hour	55 cals. per mile	2.7	1.8	0.7	0.3
4.0 miles per hour	66 cals. per mile	3.2	2.2	0.8	0.4
5.4 miles per hour (For person weighing 150 pounds)	105 cals. per mile	5.1	3.5	1.3	0.6
Running at the rate of: 5.5 miles per hour (For person weighing 150 pounds)	91 cals. per mile	4.4	3.0	1.1	0.5
The "daily dozen," 13 minutes of strenuous exercise	150 cals.	7.3	5.0	1.9	0.9
Climbing a 30-percent grade at the rate of one-fifth mile per hour	147 cals. per hour	7.2	4.9	1.8	0.9
Bicycle riding on level road at rate of nine miles per hour.	313 cals. per hour	15.3	10.4	3.9	1.9
Typewriting rapidly	52 cals. per hour	2.5	1.7	0.6	0.3
					teaspoonsful
Sewing by hand	4 to 9 cals. per hour	0.2–0.4	0.1–0.3	.05–.1	1.2–2.7
Sewing by foot-driven machine	34 cals. per hour	1.7	1.1	0.4	9.3
Sewing by motor-driven machine	8.3 cals. per hour	0.4	0.3	0.1	2.4
Ironing, dishwashing, dressing a child	24 cals. per hour	1.2	0.8	0.3	6.9

[1]Teaspoonful



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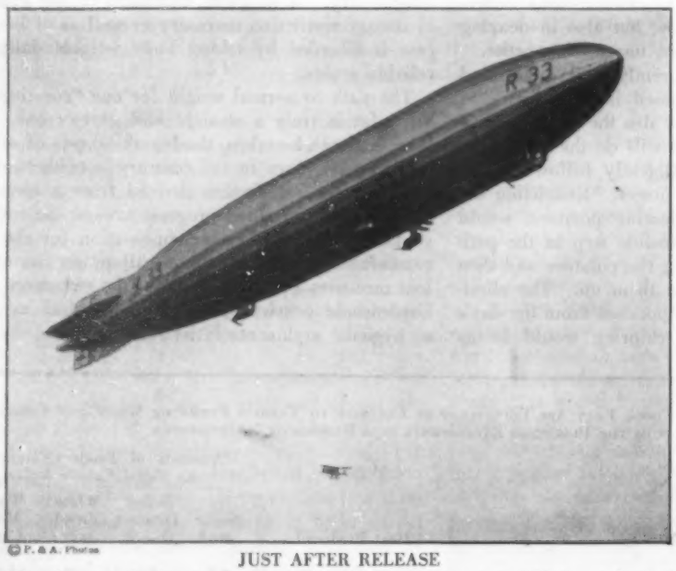
ONE OF THE SMALL PLANES IN POSITION, READY FOR RELEASE

This photograph illustrates the method that was used to fasten the planes to the dirigible. Dangerous as the feat may seem, the pilot of the plane did not enter the cockpit until after the flight was started, and then used the trap-door shown



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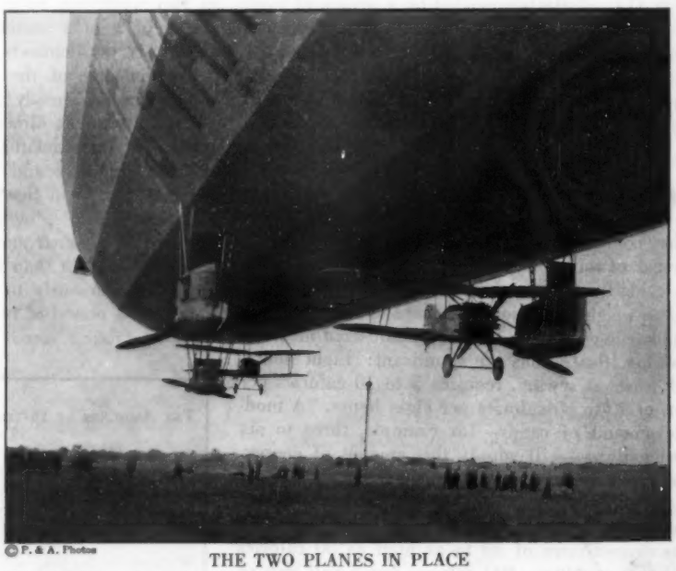
JUST AFTER RELEASE

The release mechanism has been manipulated and the plane is in mid-air. A burst of smoke indicates that the plane's motor has been started



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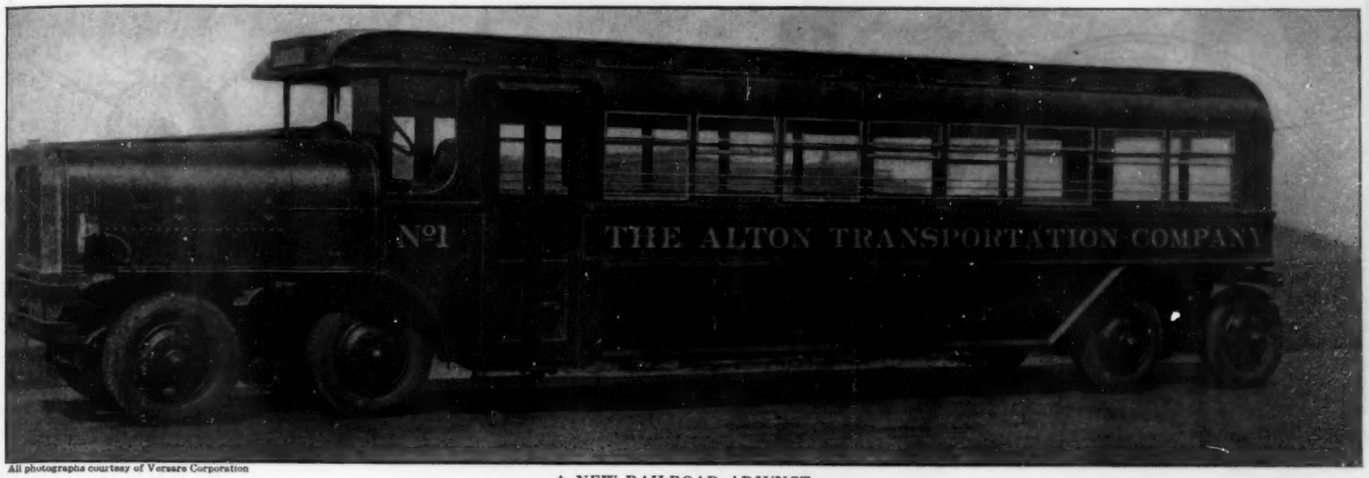
THE TWO PLANES IN PLACE

The dirigible and its tiny planes just before the start of the successful flight, during which both planes were launched from the dirigible

Two Airplanes Successfully Launched From a Dirigible

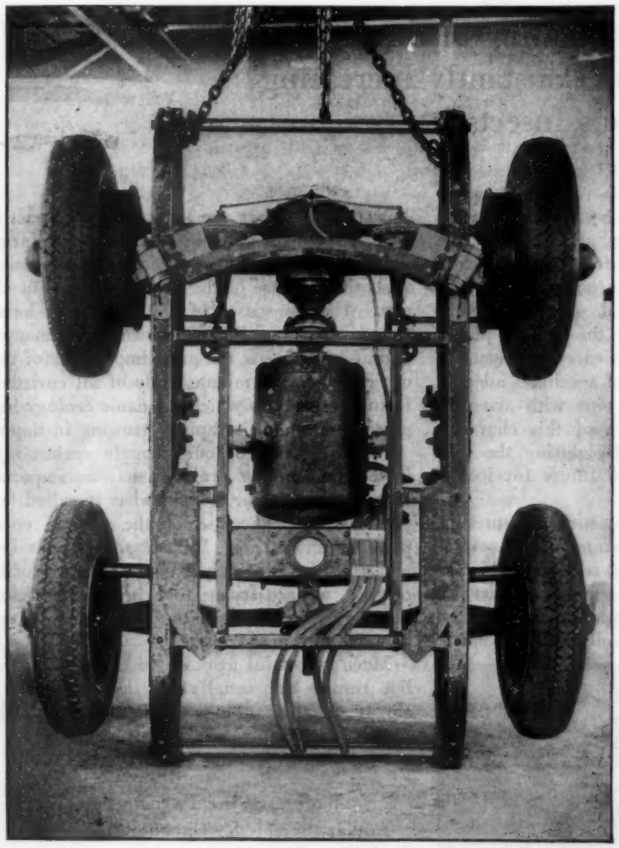
Some time ago, experiments were carried on in the United States which demonstrated that it is entirely practical to launch airplanes from dirigibles while the latter are in flight. The significance of this achievement was great and it aroused wide interest. Now, the British have taken up the same type of work and have been very successful in carrying and launching two planes from the dirigible, *R33*. The above photographs show how the experiments were carried out, and especially illustrate the method of holding the plane to the under-side of the airship. In the American experiments, there was only a single point of suspension between the two craft which obviously was superior, when the problem of re-attaching the plane while still in flight is considered. However, with the British method, it is quite probable that the plane will be steadier while attached. In the British test, the planes, of the fast Gloster-Grebe type, were piloted by Flying Officers R. L. Ragg and C. Mackensie-Richards. When the ship left the ground, the two pilots were in the gondolas but soon made their way along the interior of the dirigible and entered their planes through trap-doors. At an altitude of only 2,000 feet, the pilot of the rear-most plane pulled the release lever and dropped away from the *R33*. Within a space of 100 feet, the plane recovered and flew off under its own power. The airship then proceeded for some distance before the second plane was released and this test was equally successful. In both cases, the planes responded to the controls before dropping through a distance great enough to be dangerous to the structure of the plane. It does not require a great stretch of imagination to consider the possibility of landing passengers from commercial dirigibles by the use of small planes, while the military value of an airplane-carrying dirigible is obvious.



All photographs courtesy of Versare Corporation

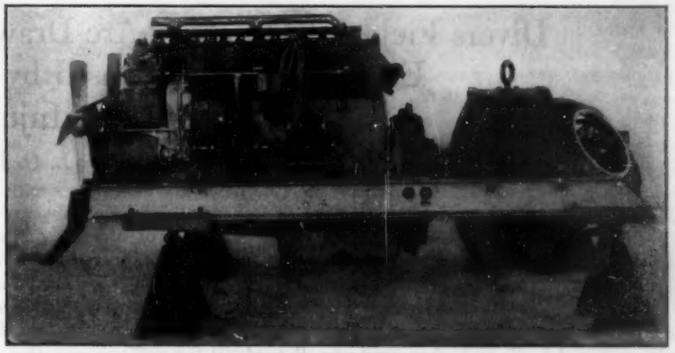
A NEW RAILROAD ADJUNCT

The body structure of this coach is built in truss units arranged in a manner that may be termed "bridge design." This construction gives great rigidity and strength with minimum weight. There being no chassis, the general design is on a unit basis wherein all the units are machined in jigs to close dimensions, making them interchangeable



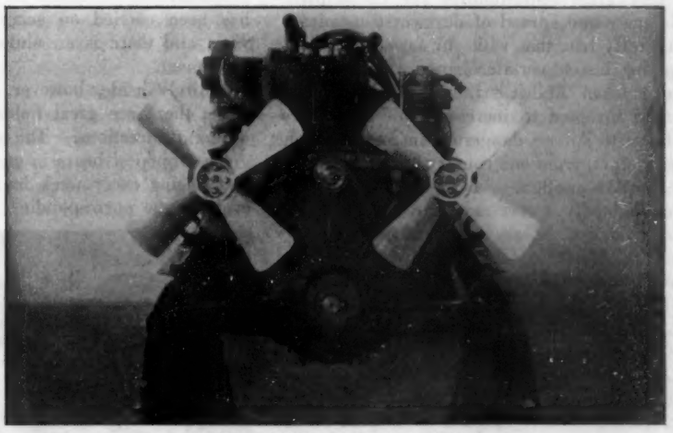
ONE OF THE FOUR-WHEEL "BOGIES"

Four-wheel bogie trucks, front and rear, each carry a 28-horsepower, 175-volt motor, driven by the current furnished from the generator. Thus great flexibility of speed-control is insured



THE POWER PLANT

This consists of a Waukesha 120 horsepower, six-cylinder engine connected to a 40 kilowatt, 1,200 revolutions per minute generator, through a disc-type coupling

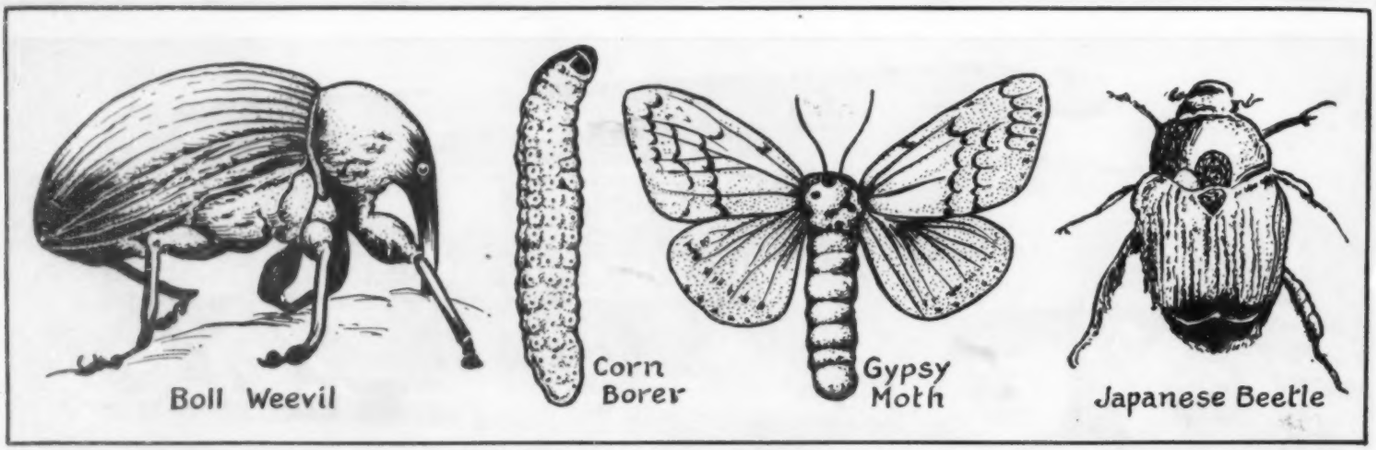


FRONT VIEW OF POWER PLANT

A sub-frame directly over the forward truck carries the power plant as a unit. In this view is shown the front end of the gasoline engine that drives the generator

The Motor Coach Aids the Railroad

Bus service is becoming more and more a part of trolley service and also, railroads are using motor coaches as adjuncts to their system or to develop unserviced territory which is tributary thereto. A most interesting proof of this are the Versare-Westinghouse motor coaches recently put into service by the Chicago and Alton Railroad, between Jacksonville, Illinois, and St. Louis, Missouri, a distance of 94 miles. They were built in Albany, New York, and are self-propelled to destination. Nearly the entire coach body is built of an alloy having a high tensile strength with the rigidity of steel, but which can neither crystallize nor rust. The air-storage tanks, the electrical braking resistance and a 52-gallon gasoline tank are all mounted under the center of the body. Seating capacity is provided for 35. Of these, 24 are accommodated on standard cross-seats and the remainder by a rotunda seat, leaving a standing space of 1½ square feet for each of 37 passengers. The "bogie" trucks swivel on king-pins, forming two complete duplicate trucks which are in reality small chassis in themselves. The turning arc is such that, although the total length of the coach is 35 feet 6 inches, it can be turned around completely in a diameter of 40 feet, the action of the forward bogie being transmitted to the rear, so that the wheels of this truck will track those of the forward bogie. The total weight is approximately nine tons.



DRAWINGS OF SOME OF THE WORST INSECT PESTS

These illustrations, many times larger than life size, show the appearance of some of the insects which cost farmers millions of dollars each year

A Great Menace—The Rising Tide of Insects

Divers Fields of Endeavor Are Drawn Upon in an Effort to Check the Enormous Waste Caused by the Constantly Increasing Hordes of Injurious Insects

By L. O. Howard

THE world is fast coming to take a broader and more serious view of the importance of injurious insects. We have always known them as nuisances, as annoying creatures that interfere with our comfort, and as enemies that damage our crops and our stored foods and other products. But as our population has increased and our demands for food have grown greater we have unwittingly created very great opportunities for the unprecedented increase and spread of our worst enemies.

It is literally true that with our farming methods we are giving insects certain chances that they have never had before. And it is literally true that every new method invented to increase rapidity of locomotion helps to spread dangerous insects from one region to another, from one country to another, from one continent to another.

It is undoubtedly a fact that, had we not grown cotton over such great areas and in just the way that we have grown it for years, the boll weevil would still be a rather rare insect breeding in the bolls of the cotton plant in portions of Central America, instead of existing as now in countless millions and costing our planters three hundred millions of dollars a year. A modification of plantation practice would have delayed greatly the spread of this notorious pest and have saved a great part of the enormous waste it has caused.

Nature Our Ally

This is only a single instance, and we might go on for several pages reciting ways in which we have helped these abominable creatures to increase and spread. We are fighting them in many ways, and the number of men trained for this work is increasing rapidly. Our agricultural colleges and some of our great universities are giving courses to increasing numbers of students who see in this rapidly growing menace an opportunity for important work.

Down to the present time we have been fighting the pests largely by chemical or mechanical means. Poison sprays and machinery for applying them have come into very general use against many different kinds of insects. The ingenuity of the mechanical engineer for years has been utilized in the perfecting of spraying machinery, and of late in the design of improved machinery for dusting certain crops with poison dust. Still more recently the airplane has been brought in, and such satisfactory results have been gained from the use of planes built for war purposes that great encouragement has been given to the construction of machines adapted for air-dusting of large-scale crops with arsenical preparations. Commercial work of this character has been carried on successfully during the past year, and there is an undoubted future for its development.

Entirely aside, however, from such measures as these, there are great fields opening up in several different directions. The exact relations which a given crop pest bears in every stage of its existence and during every week in the year to the attacked crop in the corresponding period must be known.

PARASITE COLLECTORS

These women bring in various enemies of destructive insects, which are used to combat the latter

It has happened in the past that such exact knowledge has led to some slight variation in farm practice which, while not necessarily too expensive, prevents the increase of the insect to the point of damage. The few cases of this kind that have been found, lead us to hope confidently for many others and also emphasize the great importance of the most careful and most minute study of all environmental factors, a study to which the name *ecology* has been given, and which is rapidly growing in importance.

Another aspect of our struggle against injurious insects, and which probably has an important future, is the attempt to gain what is called "natural control" from the use of the natural enemies—parasites and others. With imported pests (and the majority of our principal insect pests are of foreign origin), we are trying to bring about the natural balance by importing the insect enemies of the accidentally introduced insects.

Much successful work of this kind has been done, but results are usually not rapid—nature works slowly in these things—and to understand completely each individual problem, we must follow out long and careful studies.

Watching the Parasites at Work

Just at present the United States Department of Agriculture has its experts working in different parts of Europe, in north Africa, and in Japan, China and India, searching for and studying the parasites of several of our imported pests, notably the gipsy moth, the European corn-borer and the Japanese beetle. With the enemies of the gipsy moth, reasonable success has already been reached, but the work has been carried on ever since 1905 with the exception of the four years of the great war. With the other work we have not as yet reached conclusions of any great value; but a few parasites of the European corn-borer have been brought over, multiplied in the laboratory and liberated, and these may alleviate to some extent the great damage to corn which threatens us as soon as this destructive creature enters the great corn belt of the west.

Last autumn there was a conference of experiment station directors and agricultural officials in

Ohio, Michigan and southern Ontario to make plans for combating the certain spread of the borer; and at Chatham, Ontario, they were shown something about one of the parasites that has been imported by the United States Government, established in this country and sent to Canada for the assistance of the Canadian farmers. In one cage they were shown thousands of fertilized females of an Ichneumon fly known as *Exeristes roborator*, and this cage was carried to a nearby field in which every stalk was infested by the borer. The parasites were liberated in full view of the whole party of more than one hundred persons. Although it was a cold, raw, windy, overcast day, the parasites began at once to search for larvae hidden in the stalks and to lay their eggs through the tough epidermis of the stalks. This delighted the observers. Some of them, not believing that the parasites could locate the borers from the outside, dissected the stalks, only to find in all cases that the parasite had unerringly deposited its eggs on the hidden caterpillars. From this particular species of parasite we may expect much assistance.

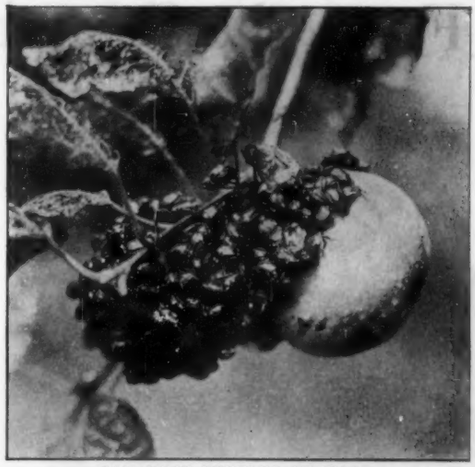
Man Versus Insects

The full solution of the corn-borer problem (and the threat of this insect is very great) will by no means be the work of parasite introduction. It will come undoubtedly rather through the general adoption (possibly through enforcement by state laws) of a modified system of growing and harvesting corn and by the prompt destruction of the stalks after harvest. The problem is complicated by the fact that the insect breeds in many other plants beside corn, including a number of weeds that grow commonly in the corn belt.

However great the damage done already by the boll weevil, the Hessian fly, the codling moth and a host of others, and however great the threat of more recent introductions, such as the European corn-borer and the Japanese beetle, it is not my purpose here to discuss particular insects, but to emphasize the prospective damage from insects as a whole.

Entomologists have not exaggerated when they have said many times in recent years that insects are much better fitted for existence on the earth than is the human species. Nor have they exaggerated when they have termed the insects, and the disease-bearing micro-organisms, the most dangerous and powerful enemies and rivals of man.

If we accept these conclusions (and they are obvious to the informed mind), we must devote far more thought and energy to their study. Many different kinds of minds must be brought into play.



JAPANESE BEETLES AT WORK

When swarms of tiny beetles like the one shown, begin to attack orchards, there is little hope for the survival of fruit. Here they are devouring an apple

First, there must be of entomologists (and there are many different kinds); and an army of these men, all with the best preliminary training, must be studying every aspect of insect life—taxonomy, morphology, embryology, physiology, pathology, ecology and psychology. We must know absolutely all about insects. And it will take a big army of trained men to do this. Further, it will take trained men of many nations; for this is not one country's fight; it is a fight to protect the human species.

While there must be many more trained entomologists, and while the entomologists are not exactly crying out for help, it is still perfectly obvious that all kinds of trained men must assist. Not only the agronomists and the plant physiologists, but men apparently as far afield as the chemists and the physicists must bear a hand.

Great skill in chemistry will be necessary in working out the processes of digestion and nutrition in insects. Chemistry is needed in the study of insecticides, either in gaseous, liquid or dust form; and it is needed also in the close study of the chemical composition of plants in the effort to find out just why certain plants attract certain insects. This last fact once learned, possibly attractive poisoned baits may be found that may be prepared cheaply. Such a study of the cotton plant has been made recently by one of the government chemists, Dr. Frederick B. Power, and certain of his findings are now being tested at the government boll-weevil laboratory at Tallulah, Louisiana. It should be stated also that the Chemical Warfare Service of the Army has been experimenting against the boll weevil in Georgia during the past summer with certain preparations evolved in the course of their Army work.

The physicist must also be brought in, although at first glance this is less evident than with the chemist. An interesting study has been carried out by the Bureau of Standards in the effort to learn why calcium arsenate in dust form adheres to the cotton plant when thrown in a dust cloud from a rapidly moving airplane and does not so adhere when thrown upon the dry plant in the middle of the day from horse-drawn machines. There is apparently the question of possible electrification of the particles thrown from the airplane. The whole subject of the possible bearings of electricity in the fight against insects is not yet explored. Any one of the discoveries in physics recently made or just on the verge of being made may have distinct application in this warfare. Already through recent discoveries we are able to hear minute insects working in masses of stored grain and hidden insects working under the bark of trees.

Labor of 1,000,000 Men Lost Yearly

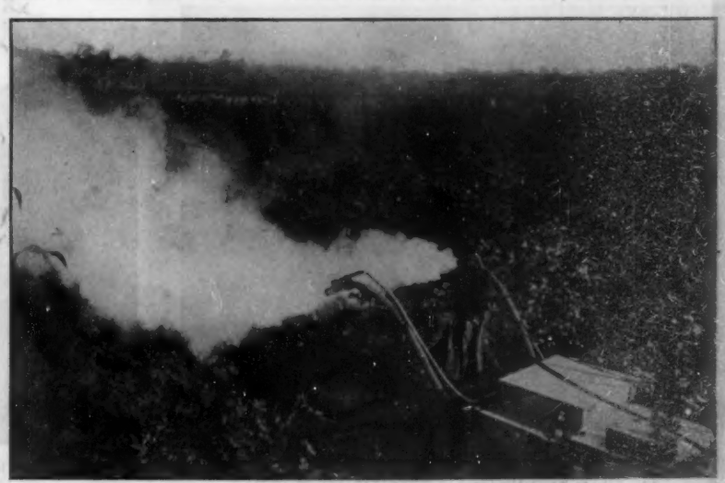
The entomologists at Washington estimate the annual loss of the United States through the work of insects at something over two billions of dollars each year. It has been stated that there is an economic fallacy in such estimates of financial loss, on account of price fluctuations. But to put it in terms of lost labor we have something perhaps more understandable. Each year the expended labor of approximately one million men is lost through the effort of insects to feed and propagate.

It may be that Professor East and the other recent prophets who picture the approaching of race starvation through over-population of the world are wrong—at least, that they are wrong as to its nearness. It may also be that new foods or cheaper ways of producing the old foods will be invented or developed. It may be that measurable birth control will be adopted gradually. These are "maybes." But what is certain is that here is an enormous waste and that humanity should devote its strongest endeavors to stop the constantly increasing hordes of injurious insects and to fight them, if possible, to the point of extermination.

The difficulties encountered by engineers who are building railroads in certain parts of the United States do not differ materially from those of pioneering days. The illustrated story of some of the new constructional work and difficulties will be told in an early issue.

IN A FIELD INFESTED WITH CORN-BORERS

Notice in particular the absence of tassels on the corn stalks and many other indications of serious infection from insect sources



DUSTING COTTON WITH CALCIUM ARSENATE

This is one of the methods that has been evolved to battle the boll weevil which annually makes great inroads in our cotton crop

From the Scrap-book of Science—Came

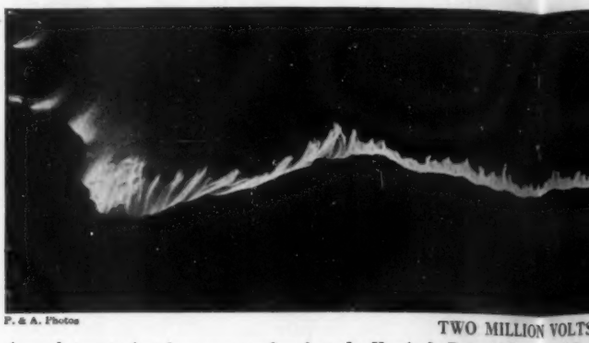
THE LARGEST COELOSTAT

Ferdinand Ellerman of the Mt. Wilson Observatory studying large, recent sunspots with the largest sun-telescope in the world. Mirrors above, at the top of a 150-foot tower, reflect the sun's image downward to the circular horizontal screen

Wide World

SUBMARINE "MOVIE" CAMERA

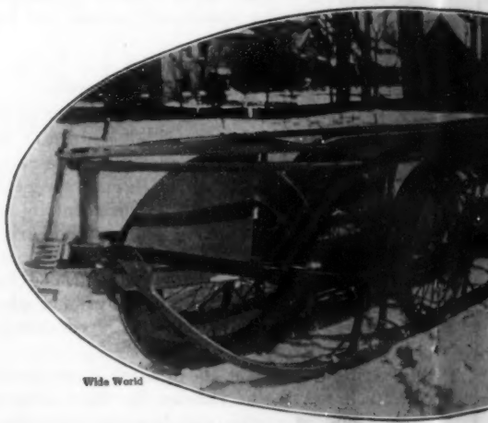
LEFT: *Dr. Paul Bartsch of the National Museum recently conducted an under-water motion picture hunt for fishes near Florida. This camera is described in the Scientific American Digest of the present issue*



P. & A. Photos

TWO MILLION VOLTS

A spark twenty feet long was produced at the Harris J. Ryan high-voltage labo order to anticipate future high-tension power transmission developments, electrica are experimenting with voltages much higher than t



Wide World

MOTOR SLED USED IN CANADIAN MINI

In the mining districts of northern Ontario and western Quebec s are being used for winter communication. In front of the forward is followed by the endless belt. The front whee

P. & A. Photos

ENDURANCE TEST IN POISON GAS

In Great Britain, picked men are kept in rigid training in buildings especially constructed to simulate conditions during mine disasters. In this picture a man is shown making a dynamometer test of endurance in gaseous atmosphere

Wide World

WHENCE COMES THE COSMIC RAY?

In order to experiment on the cosmic ray, which was analyzed two years ago by Professor Millikan, a trip was made last summer to Bolivia, where conditions favor the research more than in this country. A high altitude, snow-fed lake free from radioactive waters is the prime requisite

International Newsreel

FIRING NEW COAST-DEFENSE G

Since the World War almost every kind of war material has been at Ft. Wadsworth, is of the new French 155-m

International Newsreel

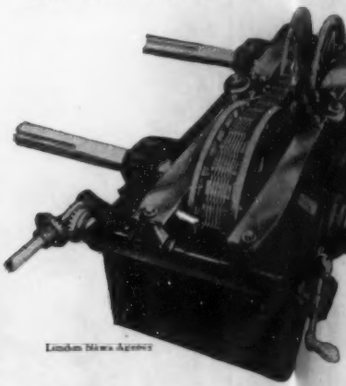
ALASKAN MOUNTAINS, FROM AN AIRPLANE

The United States Government has been conducting a survey of relatively inaccessible parts of Alaska, by means of airplanes. Where there is no need of a detailed survey this method is inexpensive

Harris & Ewing

HELIUM REPLACES NITROGEN IN DIVERS' AIR SUPPLY

If the nitrogen in the air ordinarily breathed by divers be replaced by helium, the diffusion of the air through his tissues is accelerated. This enables him to "decompress" (rise to the surface) more rapidly. In photograph, a Bureau of Mines chemist is decompressing a cylinder of guinea-pigs in helium air

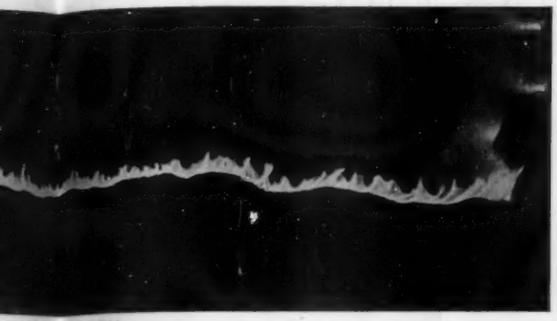


London News Agency

NEW APPLICATION OF OLD MECHAN

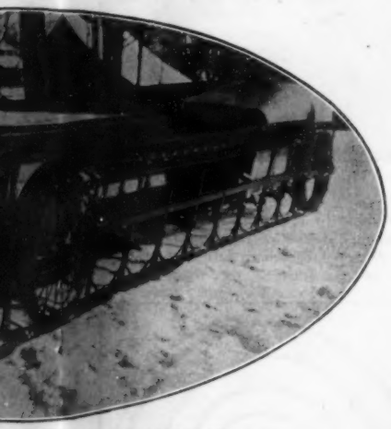
Speed-changing devices resembling the one shown this is the first one having a positive, non-slip drive, ment the chain engages lugs on the side rims, no

Camera Shots of Scientific Happenings



MILLION VOLTS!

high-voltage laboratory at Stanford University, Palo Alto, California. In lopments, electrical engineers, endeavoring to obtain a greater safety factor, nuch higher than those they soon expect to use

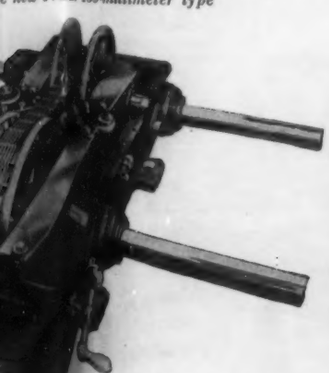


CANADIAN MINING DISTRICT

western Quebec sleds built like track-laying tractors ont of the forward wheels a sled breaks the trail, which lt. The front wheel is for steering

OAST-DEFENSE GUNS

ir material has been improved. This gun, being tested e new French 155-millimeter type



N OF OLD MECHANICAL PRINCIPLE

nbling the one shown above, are not new, but positive, non-slip drive. By an ingenious arrangeon the side rims, no matter what their diameter

Science Service

HOW ANCIENT?

LEFT: *Dr. J. W. Gidley of the National Museum, with the skull of a prehistoric woman, which he found in Melbourne, Florida. It was found with those of camels, horses, glyptodons and mammoths. This, Dr. Gidley regards as evidence that men lived there before these animals disappeared*

AUTOMATIC CAMERA "SHOOTS" BURGLARS' PICTURES

Frequently in the past amateurs have rigged up automatic cameras to photograph thieves. Here, however, is the same idea put into more finished form. The usual camera lens is concealed in order to prevent the thief from suspecting that he has been photographed, and perhaps smashing the evidence

Science Service

TWO NOTED PRIEST-SEISMOLOGISTS

The Rev. F. A. Tondorf, S.J., in charge of the Seismograph Observatory at Georgetown University, Washington, D. C., and the Rev. James B. Macelwane, S.J., seismologist of Saint Louis University, with the new Galitzin seismograph. This type is altogether more accurate than those formerly used

Photo by Angus Parkinson

COLLEGE PROFESSOR IS "RADIUM DETECTIVE"

Seven times in the past few years, Prof. J. B. Edwards of the Georgia School of Technology has been called upon to find lost radium. The procedure is simple: rays from nearby radium will discharge the electroscope which he holds

International Newsreel

HOW NOISY IS NEW YORK?

Dr. E. E. Free, former editor of the Scientific American, testing a noisy corner of the world's noisiest city by means of the audiometer, an apparatus which eliminates the guesswork factor in the estimation of sound intensity

P. & A. Photos

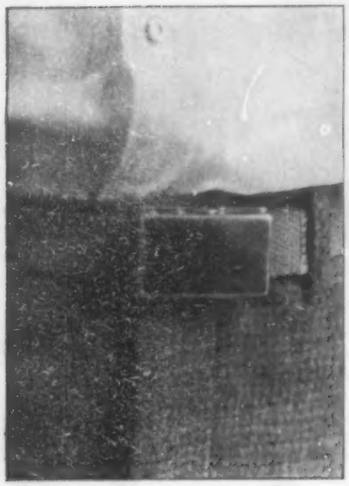
ICE RINK—BALLROOM FLOOR IN CHICAGO

Laying the pipes for the refrigeration. Parallel iron pipes were laid and covered with two inches of concrete. To change to a ballroom floor, hot water is run through the pipes, melting the ice

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

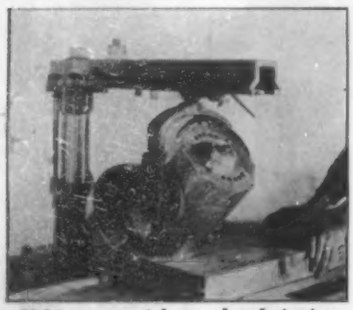
Conducted by Albert A. Hopkins



Matches conveniently placed

Conserving Food Losses

THE importance of bringing to the table the precious mineral salts and solubles of all our vegetable foods, instead of removing them to the cooking water and draining them off into the sink before serving the vegetables, has been established.



Making a special cut—bevel ripping

"Steamit," an adjustable steaming grid, will do wonders in solving the problem of efficient cooking. The grid is made adjustable to fit different sized pots, within certain limitations. It lies snugly therein and the meat or vegetables to be cooked are placed upon it. The water barely covers the bottom of the pot and the steam is not allowed to escape. A small flame will maintain a heat of 180 degrees Fahrenheit in the covered utensil. Meats, fish and poultry are cooked in the same way. They not only retain the juices and flavor, but the value of the mineral salts, as well as the vitamines and other health giving properties are conserved. The saving in shrinkage is also a matter of importance.

The adjustable steaming grid in place in the pot

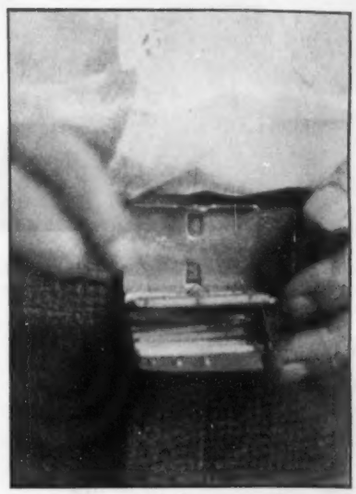
Combined Match Box and Belt Buckle

IN the device illustrated, the wearer always has his matches right with him, for the match box is hinged to the belt buckle, and is of the proper size for carrying matches. The box fastens to the buckle by means of a special clamp.

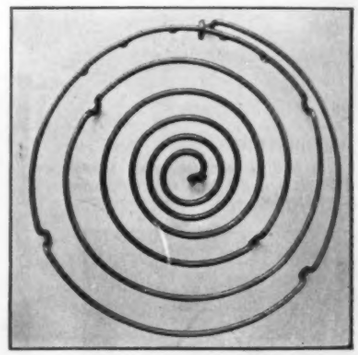
A Universal Woodworker

ONE of the most interesting exhibits at the Sesqui-centennial Exposition, was a universal cutting and grinding machine of many uses. This tool will do cross-cutting, compound mitering, bevel ripping, straight ripping, dadoing and gaining, ploughing and rabbeting, panel sinking, disc-sanding, routing, tenoning, shaping, metal sawing and grinding. With attachments, it can be used to drive a lathe, a jig-saw or a belt sander. With the aid of a flexible shaft, it can be used for boring and screwing.

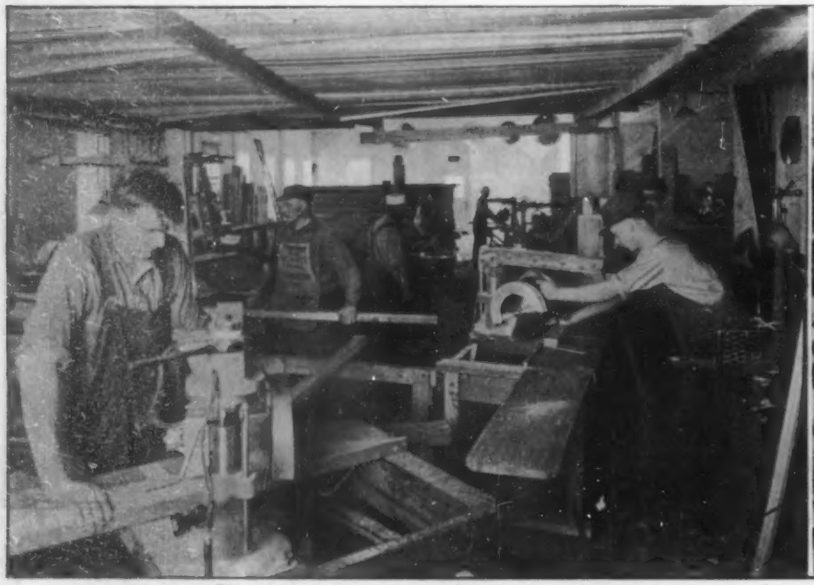
The device consists of an electric motor mounted in a yoke hanging from a horizontal arm. All the various saws, cutters, grinding wheels, et cetera are mounted on the motor shaft. The whole machine can be turned to any desired angle and moved along the horizontal arm, or held stationary at any point so that virtually any cutting operation that can be done by any machine, can be done by this versatile device. It is light enough to be carried around by two men. Some of the more ordinary uses are shown in our illustrations. Not a single belt is necessary in any of the primary uses of the machine. It is supplied with either alternating- or direct-current motors.



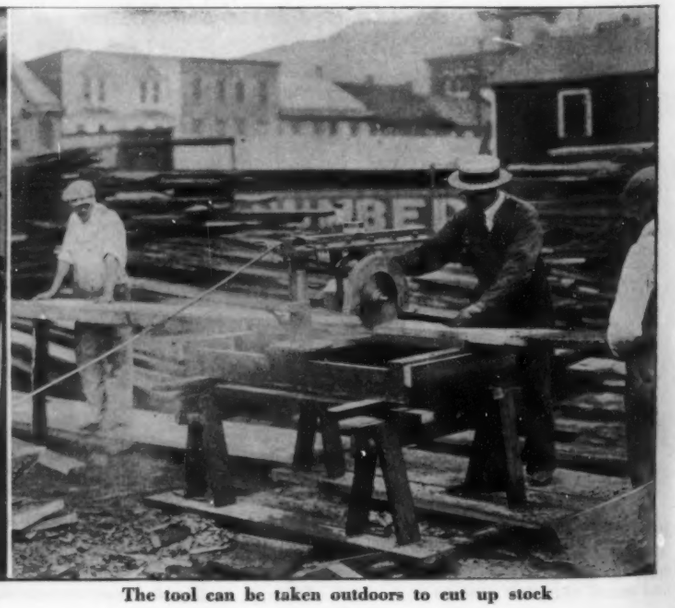
The match box opened



The grid is adjustable



The tool of many uses in the carpenter shop



The tool can be taken outdoors to cut up stock

Liquid measure, strainer and funnel

New Measure Conserves Lubricant

THE new type of oil-dispensing measure illustrated in these columns holds several advantageous features over the kind that have formerly been in common use. As shown in the upper left-hand illustration, the device combines the functions of a liquid measure, a funnel and a strainer. The flexible spout is so arranged that it can be used to direct the oil to any desired opening, such as the filler-hole in an automobile crank-case. The oil in the container will not start to flow until the thumb lever is depressed and will stop immediately when the lever is released.

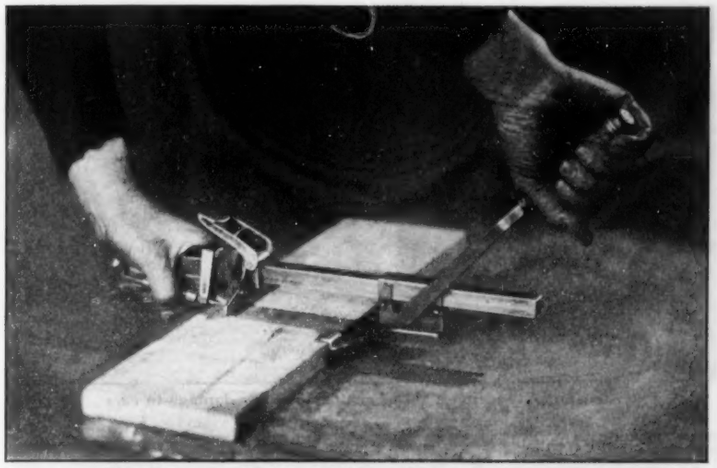
Setting Hinges Quickly

BY the use of the cleverly designed tool shown in the top center photograph, a complete hinge can be mortised in with little loss of time. In fact, it is said that the time required is only from one-half to one minute. The tool need only be set for the width and depth of the cut, after which no further measurements are necessary.

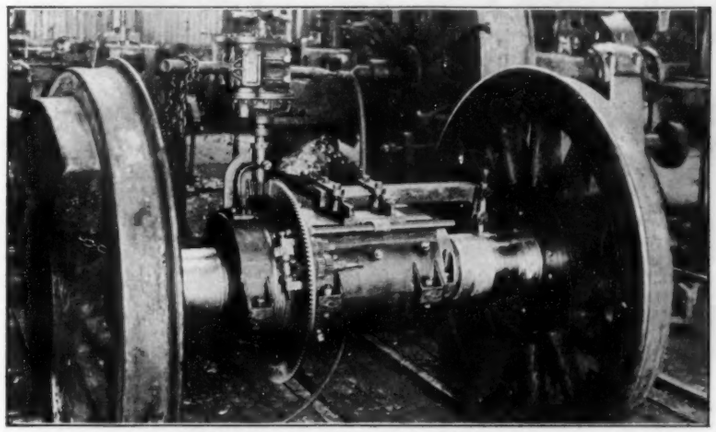
Electric Hand-saw for the Butcher

AN electric hand-saw for sawing meat has been perfected by a San Francisco company. The saw is circular and can be used for every operation from cutting chops to breaking beef. It is suspended above the butcher block or table by ball-bearing rollers which travel on a shaft hung from the ceiling or wall or supported by uprights from the floor. An extremely important feature is the gravity guard which is raised as the operator grips the handle preparatory to pulling the saw down for use, and is released as he lets go.

Exchanging warm bottle for cold



This hinge mortiser is a tool for the progressive carpenter



Truing up journals without removing the drivers

Driving Wheel Axles Trued Up in Place

THE machine illustrated in these columns is designed to true up journals on the driving-wheel axles of a locomotive without having to entirely remove the drivers from under the locomotive. It is intended primarily for use in the roundhouse for quick repairs.

The machine consists of two principal parts, namely: the stationary or inner sleeve which is provided with suitable clamping mechanism for clamping it firmly on the central part of the axle, and the outer or revolving sleeve which rotates on a bearing on the inner sleeve and holds the carriage for the cutting tool as well as the feed mechanism. The outer or revolving sleeve is driven by a large bevel gear through a pinion by means of an air motor fitted on a taper shank, or by an electric motor through belt and pulley. The tool carriage operates on a dovetail type of bearing.

One can work in an erect position with this lawn trimmer

A time-saving saw for the butcher

Trimming Grass in Comfort

THE grass-trimmer illustrated in the lower center photograph is so designed that the operator can work while in an erect position instead of having to get down on his hands and knees. The essential parts of the construction are clearly shown. A device similar to an ordinary pair of shears is fastened, by means of a swivel, to the lower end of a long shaft. The jaws are so arranged that they can be worked from a pair of handles located about waist high.

Novel Bottle Cooler and Dispenser

NOVELTY, speed and usefulness have been incorporated in the new bottle cooler and dispenser illustrated. A rack on the top of the dispenser is made to hold eight different kinds of soft drinks. The lower part of the cooler has eight tubes running in a half circle through an ice-filled compartment. When a customer calls for a certain kind of a drink, the clerk simply takes a bottle out of the rack and presses it into the proper place in the cooler. This action forces out a cooled bottle of the beverage on the other side.

The cooling cycle illustrated

This safety hook prevents unlocking of the automobile tow-line

Tow-Line of Unique Construction

IN an emergency, a motorist will resort to almost anything that will make an improvised tow-line, but if he carries one of those illustrated in the top center photograph, he will always be sure of getting out of trouble. This new line has a compression spring in the center that takes up shocks and prevents the unpleasant jerks that are usually attendant to towing. Also, the line is equipped with safety hooks at each end that make fastening easy and always secure.

A Much-traveled Dog

EVIDENTLY, "Cactus" does not mind automobile riding. In fact, he has traveled 30,000 miles in a specially-built limousine-type carrier which is attached to the running board of the car. In case of inclement weather, "Cactus" has his own storm curtains to protect him from the elements. An adaptation of this device might be made for any car, and could be constructed by anyone mechanically inclined.

Combining Radio and Phonograph

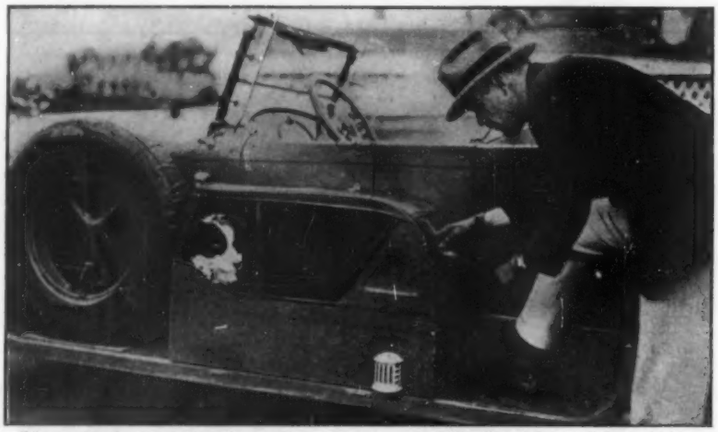
THE well-designed audio-frequency amplifier and loud speaker of a radio receiving set may now be used to reproduce phonograph music with great volume and perfect fidelity of tonal quality. The device that makes this possible is the "gradeon" illustrated in these columns. It consists of a special electrical pick-up, a volume control, and a plug as shown.

To make use of this electrical phonograph arrangement, the present sound box is removed from the tone arm and replaced by the electrical pick-up; the volume-control box is placed in a corner of the phonograph and the plug, on the end of a long flexible cord, is inserted in the radio set in place of the detector tube. The rest of the tubes are removed, with the exception of the audio-frequency amplifiers, and the filament controls are turned on to the normal point. It is said that the reproduction is superior to that of the ordinary phonograph.

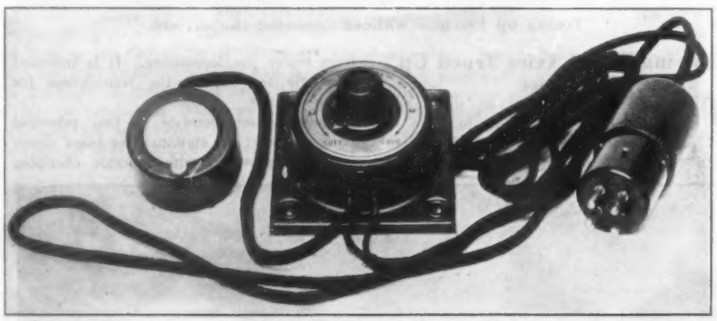
Super-Luxury in the Pullman

PULLMAN service has furnished the American traveling public practically

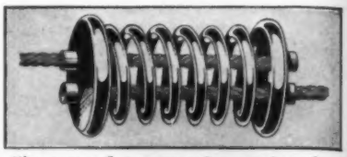
A tow-line with a shock absorber that prevents damage to cars



Limousine-type carrier for canine passengers. This dog "Cactus" has ridden over thirty thousand miles in this home



Making the phonograph super-orthophonetic by combining it with the audio-frequency amplifier of a radio set



Close-up of compression spring for tow-line shown in use at left

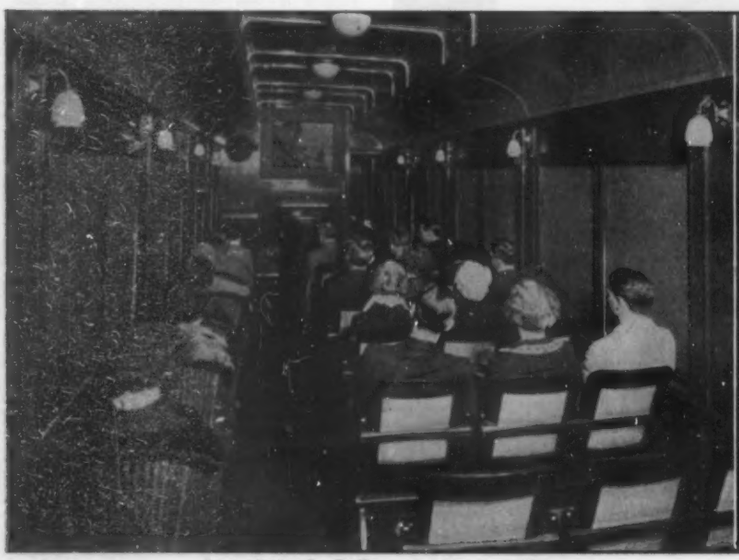
all the comforts awheel that it has known, from the days of old Number 9, George M. Pullman's initial venture of 1859. Better and more luxurious sleeping cars, dining cars, parlor cars, club cars, observation cars and private cars followed, annually increasing the comfort and safety of Pullman passengers. Now appears an entirely new departure in railroad travel. It is the entertainment car, operated on some of the all-Pullman "land cruises" managed by the Raymond and Whitcomb Company.

The photographs perhaps give a better idea of the novel joys which the recreation car furnishes to those taking long rail journeys, than can the written word. However, the latter can supplement the evidence furnished the eye through a description of the pastimes and other pleasures afforded patrons.

The recreation car is 82 feet long and the entertainment hall proper occupies 38 feet, 1 inch of this space. One of the pictures shows the hall in use for a moving-picture exhibition. There are accommodations for about 50 seats without crowding. The room is also available for lectures and religious services. When dancing is in order, the chairs are stored at either end of the car in special lockers, and a phonograph or radio receiving set furnishes music. Fifteen couples can dance without crowding.

One end of the car, 12 feet, 5 inches in size, is outfitted as a gymnasium that is used by both sexes. A mechanical horse of the type popularized by ocean travel is there to jog off superfluous weight, and punching bag, medicine ball, chest weights, and rings offer variety to those to whom exercise is both a pleasure and a necessity. The moving-picture machine is located in the "gym," projecting through the wall. The other end of the car contains a barber's shop with shower-bath annex and, beyond, a library lounge that seats six. There are also shelves for 100 books and a table for current magazines.

A special type of car is provided for the same train, its outstanding feature being a drawing-room containing a fixed bed with regular upper berth, and a folding bed that, being out of the way in daylight hours, permits unusual space for chairs. This room also has a shower-bath as well as the usual private toilet facilities.



A movie in the Pullman car is a novelty

The Pullman-car gymnasium becomes a ballroom

Here is a novelty in the way of hot-water bags. The hollow rubber mask holds hot water and conforms to the contour of the face

A Hot-water Face Mask

A WOMAN inventor of Lockland, Ohio, has invented a unique "water-bottle" mask which fits snugly over the face. Our four illustrations show how the mask is filled and attached, and also indicates how it looks when in use. It cannot be said that the result is a thing of beauty, but it would come in very handy in cases of toothache and neuralgia. The device is simply a double-walled rubber mask having space between the walls for either hot or cold water. It weighs only about 12 ounces when empty, and holds a pint of liquid.

Head-bands are provided so that the mask may be shaped to fit the head of the wearer. Once adjusted, the mask may be placed on the face as easily as putting on a hat. The tape around the neck is not absolutely essential as the mask fits snugly to the chin. The device is so designed that it does not bulge at any point—the water being distributed evenly throughout the container. The masks are made in several sizes so that all faces may be fitted.

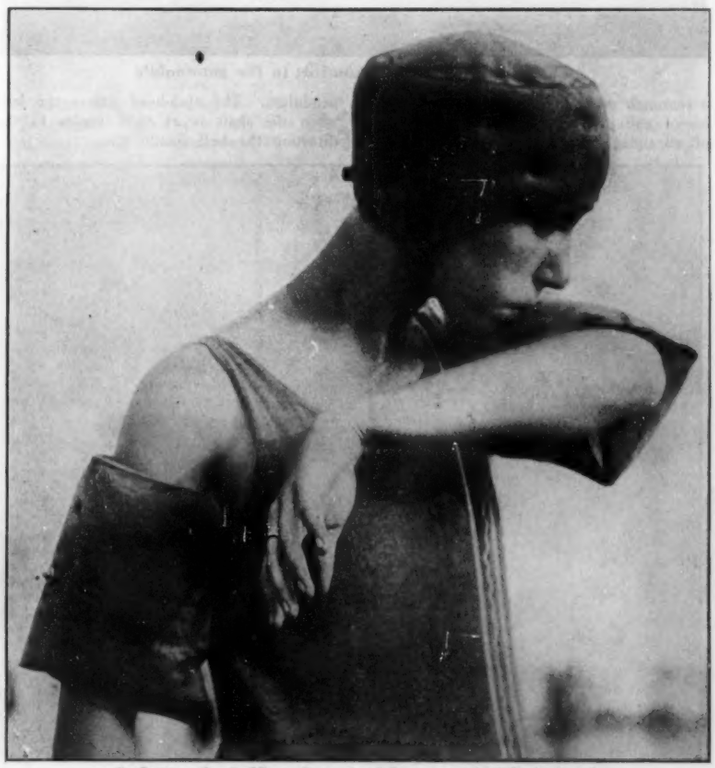
Swimming Aids for the Novice

TWO excellent devices were shown at the shore last summer. We reproduce photographs of them in these columns. One consists of a pair of sleeves which are to be inflated after they are slipped on the arms. These are found to be very efficacious in supporting the body in the water and will prove a great help to those who are learning to swim.

The other device is a surf cap which is also an aid to the swimmer, serving to keep the head above the water. This gives confidence to those whose greatest difficulty in acquiring the swimming art is the fear of the head going under. Air is blown into its double wall, the cap is pulled down over the ears to secure a snug fit and to keep the hair and ears dry. The cap conforms to the irregularity of the head, making the entire surface of the cap snug and tight without discomfort.

Enjoying a swim with the aid of rubber sleeves and cap

A simple hose clamp



Inflating the rubber sleeves—the cap is already inflated

A New Hose Clamp

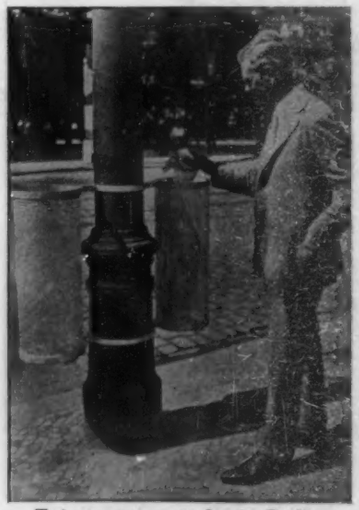
A LOS ANGELES inventor had devised an exceedingly efficient hose clamp, which is illustrated in these columns. The thumb-screw and the screw with an interrupted thread serve to pull the wire cable extremely taut, while the transverse yoke acts as an anchorage for the other end of the wire. With the aid of this device, hose can be fastened to any piece of pipe. The cable gives an even, concentric pressure that eliminates all leaks.

Rubber-lined Barrel and Rubber-faced Paddles

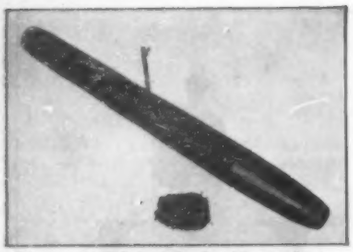
A WESTERN concern has introduced an impact pulverizer which includes, among other novel features, the replacement of the usual iron or steel lining with a soft rubber lining and soft rubber faces on the blades, according to *The India Rubber World*. It is said that the liner and paddle facings wear ten times as long as tool steel, for the soft rubber is resilient and does not abrade. When renewal is necessary, they can be replaced at a fraction of the cost of steel and with but a small part of the labor required to install steel blades and liners.

Keeping Berlin Clean

THE street cleaning department of Berlin, Germany, have devised a very clever attachment for electric-light poles and other street pillars in the form of holders for waste papers and other debris. The baskets are two in number for each pole and the wire-mesh containers can readily be released for emptying. We could use a device of this kind in our own large cities to great advantage.



Twin waste-receptacles in Berlin



The steel tube packed with explosive and equipped with a fuse

Splitting Logs with Explosive

INSTEAD of using the old, time-consuming method of splitting logs by means of wedges, a new system can be employed. It consists of using the destructive force of an explosive to disrupt the log. Powder is packed in a long steel tube which is inserted in a hole drilled lengthwise in the log. A fuse is ignited and the force of the explosion accomplishes the splitting. It is said that eight cords of wood can be split in one day, using this new method.

An Ancient Flat-iron

IN looking over the large stock of a dealer in household articles, we found an old flat-iron which seems to be a missing link between the present-day iron designed to be heated on a stove and the gas or electric iron. The upper portion of the iron is brass and the lower, or pressing surface, is of iron. The base is hollow so that hot coals or charcoal can be inserted. Such irons were formerly in use abroad and probably are used yet in rural districts in Europe where electricity or gas is not available.

Serving Tray for Road-side Lunches

MEALS and drinks served in automobiles are apt to be more or less messy, but with the contrivance shown, the annoyances are minimized. This device consists of a metal tray adapted to be secured to the side of the car or the doors in such a way that there is no injury to the varnish. Our illustration shows the device in use.

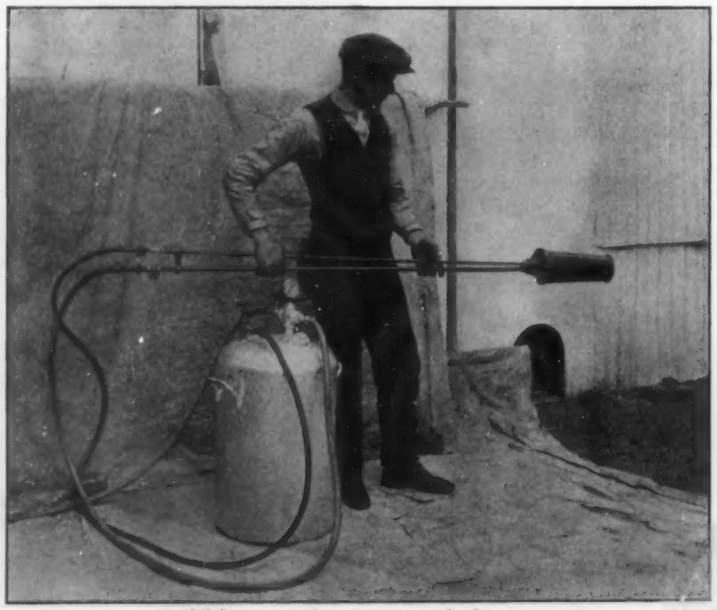
Golf by Machinery and Golf by Physical Culture

MR. P. A. VAILE, author of a number of books on golf, and who has recently contributed an interesting article to the Scientific American, calls our attention to the fact that many golf experts contend that "putting" cannot be taught. However, he has devised a machine by which the technique of putting can be grasped in one or two lessons. It demonstrates perfectly how to play stymies, chip-shots, cut-putts, cut-mashie and niblick shots and gives one a thorough grounding in the basic mechanics of golf. The putting machine consists of an upright attached to a base. There is a clamp at the top of the support which holds the top of the shaft so that the club, when gripped by the novice, swings like a pendulum. The club-head strikes the ball when the shaft is at right angles to the direction the ball should take.

Golf-leverage bar-bell

The explosion splits the log into six or seven pieces

Eating and drinking in comfort in the automobile



Oil burner and preheater ready for use

A link in the history of the internally-heated pressing iron

Mr. Vaile has also prepared a special dumb-bell as well as a bar-bell which aids in teaching golf. The latter is a short golf-club shaft, fitted with an adjustable weight of about a pound, so that it can be set to suit the strength of anyone, from a child to a man.

Preheating Castings

OFTEN when welding castings, preheating is necessary to neutralize expansion and contraction strains or to effect economy of gases. Without preheating, complicated castings are liable to develop new breaks at points remote from the weld after the weld itself has been successfully completed. Large castings will absorb a great amount of heat from the welding flame before a local melting heat is attained, so a gas saving can be made by first preheating the entire piece.

The oil-burner and preheater shown is primarily designed to give maximum combustion and greatest heat in the quickest possible time, thereby reducing overhead and resulting in greater output from men and machinery. It is of the atomizing type, economically utilizing the cheapest grade of crude, fuel or kerosene oil or distillate and compressed air under pressure varying from 50 to 100 pounds. The air supply-line serves two purposes. While furnishing a direct flow to the burner, the air also maintains a pressure in the oil storage-tank, creating a greater velocity in the oil feed-line, thus insuring a positive and uniform flow of both oil and air. The oil, under pressure, enters the atomizing chamber at right angles to it and in an annular form, while the compressed air flows directly through the center, striking the film of oil and completely atomizing it, then expanding it in a venturi-shaped outlet. Immediately upon opening the valves, the gas at the burner can be ignited and work started.

Golf machine perfects players

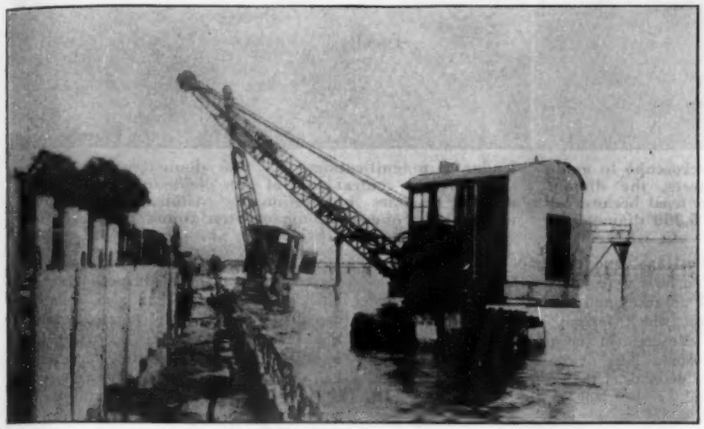
The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Guarding the Mississippi Shoreline

THE low-lying shoreline of Harrison County, Mississippi is exposed to the inroads of the sea whenever heavy storms pile up the waters of the Gulf of Mexico. The storms, as the people are well aware, from time to time take a heavy toll of property and lives, and heroic measures have had to be taken to afford adequate protection. The frightful disaster that overwhelmed Galveston led to the construction of a mighty sea wall and the raising by many feet of the level of the city behind it. Notable among the exposed sections of the southern coast is Harrison County, Mississippi, which has a long stretch of a low-lying coastline that is subject to overflow whenever the southern hurricanes burst upon it.



Amphibious cranes equipped with caterpillar treads were an absolute necessity during the construction of the sea wall

In order to protect the property in this location there is under construction an extensive system of protective works, which covers the most exposed spots in a stretch of 26 miles. The magnitude of this work can be gathered from the fact that the shortest single stretch is approximately 2,000 feet long and the longest extends continuously for four and one-half miles.

This illustration shows the heavy construction that had to be used

After investigating the various known systems of breakwaters, the authorities decided upon a step-type, built of reinforced concrete. As compared with either the vertical or the incurving type of wall, the step system has the advantage that the blow of a heavy wave is received piecemeal, as it were, and the impact, instead of taking the form of one mighty blow, is received in a series of smaller impacts.

The total width of the wall is 15 feet. At its foot, it rests upon a continuous wall of flat tongue-and-groove sheet piles, which are driven 10 feet below the surface. Back of this wall, and parallel with it, is a row of 15-foot foundation piles which are spaced 7 feet, center to center longitudinally. To the rear of these is a line of 18-foot foundation piles which are spaced 9 feet center to center. These foundation piles, which are 12 inches square, are reinforced by three-quarter inch bars. The sheet piles at the toe of the slope are 37 inches wide by 7 inches thick and 10 feet long and they are reinforced with half-inch bars. The concrete steps are reinforced by expanded metal sheets. For carrying on the work, it was necessary to build over 14 miles of narrow-gage track. The amount of material used in the wall, at a rough estimate, would total about 600 cars of cement, 3,500 cars of sand and gravel, 120 cars of reinforcing bars and over 100 cars of lumber.

* * *

A Still More Powerful Cathode-Ray Tube

A SUPER-POWER cathode-ray tube, which will take much higher voltages than the tube which he demonstrated recently at the Franklin Institute in Philadelphia, and which was described in the Scientific American, December, 1926, is now planned by Dr. W. D. Coolidge, assistant director of the General Electric Company's research laboratory. The new form of the tube is described by Dr. Coolidge in an article in the December issue of the *Journal of the Franklin Institute.*

Briefly, the method which he proposes to use is to "cascade" two or more tubes, the rays from one being fed into another, which speeds them up still further and increases their range. The cathode rays are rapidly moving electrons, small particles of electricity, moving with speeds of a hundred thousand or more miles a second. These electrons start from a small electric-light filament from which they come at speeds of merely a few miles a second. With a voltage of 350,000 they are speeded up within the tube so that they leave it with a velocity of 150,000 miles a second. By building larger tubes, it will be possible to increase the voltage to a certain limit, but when too much power is applied to a single tube, the cathode itself is bombarded by positive rays which move in opposite directions to the cathode or negative rays. This introduces troublesome effects.

By arranging two or more tubes together so that the nickel window at the end of one tube, from which the rays ordinarily emerge into the open air, acts as the cathode of the next tube, they are already moving at great speed when they leave the first tube, and when the same voltage is applied to the second tube they are still further accelerated. The window between the two tubes may be made thick enough so that it passes the cathode rays going in one direction, but stops the positive rays going the opposite way, as they are less penetrating. Another advantage of the multiple tube over a very large single one is that it is much easier to supply, for instance, four tubes with 250,000 volts each than one tube with a million volts.

Dr. Coolidge says that he will try out this arrangement of the tubes as soon as the development of the single tube has been pushed to as high a voltage as possible.—*Science Service.*

* * *

840,000,000,000,000,000,000 Miles!

EIGHT hundred and forty million million million miles is the distance of the farthest object that astronomers can see with the great 100-inch reflecting telescope of the Mt. Wilson Observatory, the largest in the world, Dr. Edwin Hubble said in a lecture at the Carnegie Institution of Washington, of which the observatory is part.

The work of Dr. Hubble with this giant instrument has shown that our "Milky Way" or galaxy is not alone in space, but that scattered around the sky are millions of other galaxies, many similar to our own, and all outside its confines. The spiral nebulae, which until recently were astronomical mysteries, are among these other galaxies, but they represent a late stage in their development, in Dr. Hubble's opinion.

"Their different forms," he said, "fall into a progressive sequence characterized by rotational symmetry around dominating nuclei. From small, compact globular masses, they flatten and expand into lens-shaped forms and then break up into the thin disc-shaped spirals." This series of observed forms of the nebulae, he pointed out, agrees well with a course of development outlined on theoretical grounds by Dr. J. H. Jeans, prominent English astronomer.

In some of the closer spiral nebulae that Dr. Hubble has observed, he has made photographs which actually show the individual stars, and from the study of these he has determined the approximate distances. But the ones that are farther removed have also had their approximate distances determined, because they all are of nearly the same average brightness. The fainter they appear, the farther away they are, on the average, and by counting the number with different apparent brightness, it is possible to determine their distribution in space.

A part of the narrow-gage railroad used for transporting supplies

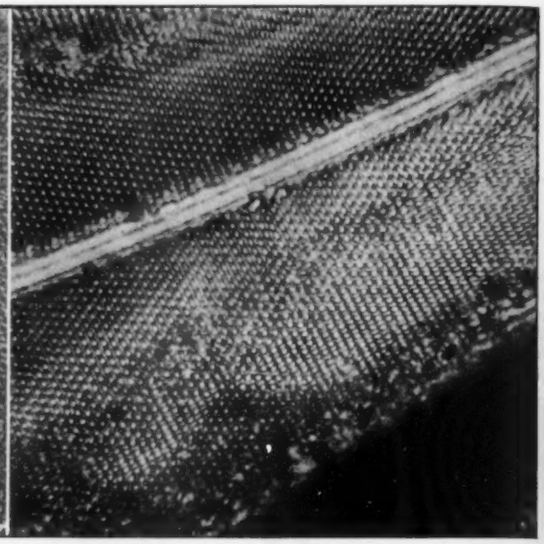
"The faintest nebulae," said Dr. Hubble, "that can be detected with the largest telescope, the 100-inch reflector at Mt. Wilson, are at an average distance of 140,000,000 light-years, a light-year being the distance which light will travel in one year, going at a speed of 186,000 miles per second. One light-year is about 6,000,000,000,000 miles. A sphere of 140 million light-years radius comprises the observable region of space. Within this sphere are some 2,000,000 nebulae, distributed in a fairly uniform manner. Great clusters of nebulae do exist, but their effect on the distribution is averaged out when large volumes of space are considered.

"The nebulae are so distant that in observing them we are witnessing scenes and events which actually occurred in past geological ages. The nearest of them all, the Magellanic Clouds, present the appearance they had back in the Great Ice Age. The spiral in Andromeda is a Pliocene object. The border of the observable region takes

One of the finished sections of the protective sea wall

The same diatom shown in another illustration, photographed under the ultra-microscope with oblique illumination. Detail of the central part was not resolved as in the next photo-micrograph

As a test of the power of a miscroscope to make visible sufficiently minute objects, the diatom *pleurosigma angulatum* is often used because of its surface detail. Magnified 5,300 diameters



Under a magnification of 7,000 diameters the minute detail of the central part of the *pleurosigma angulatum* diatom becomes unquestionably visible. Diatoms are microscopic, one-celled algae often found in pond water

us back to the late Paleozoic. Recent events are on their way, traveling with the speed of light, but only a daring prophet would expect that man will still be on earth to receive them.

"The existing limits to the observable region are of a mechanical nature; with faster plates and larger telescopes, it will be possible to push them back to several times their present distance. In fact, with improvements that are believed to be thoroughly practical today, it might be possible to detect exceptionally brilliant nebulae at a distance of a thousand million light-years, and to photograph them with light that started on its journey when the earth itself was young."—*Science Service.*

* * *

Thick Beds of Potash Shown by Texas Borings

AMERICAN potash, to break the European monopoly based on the Stassfurt fields of Germany, is a possibility held out by the results of a core drilling made in cooperation with the United States Geological Survey, in the southeastern corner of New Mexico. Mineralogists of the Survey told a representative of *Science Service* of ten beds of potash minerals aggregating nearly 30 feet in thickness, which the drill struck at depths ranging from 790 feet to 1,760 feet. They also showed samples of the core brought up by the drill; most of these consisted of light colored polyhalite, sylvite and other salts, which they stated assayed as high as 18.5 percent potash (K_2O). The beds thick enough for mining averaged about 12.5 percent, it was stated. The average run-of-the-mine minerals of the Stassfurt beds have a potash content of only 8 or 10 percent. At about 1,430 feet, one 17-inch bed of a different mineral, langbeinite, was found. This contains about 18 percent potash. Langbeinite is merely a mineral curiosity at Stassfurt.

A thin sheet of dry collodion apparently as clear as glass, magnified 2,625 diameters under the ultra-microscope

"It must not be imagined that this is simply a luck strike made at random," said Dr. G. R. Mansfield of the Geological Survey. "We have believed for years that if paying potash deposits were ever to be found in this country the most likely place to seek them would be the panhandle region of Texas and the adjacent corner of New Mexico, and we have actually been hunting for them there since 1915. We have received many indications of the presence of potash, from samples brought up by oil-well drills as well as from other sources, and recently Congress appropriated sufficient money to begin a really critical investigation. The present core drilling, however, the first of its kind, which gives us a really accurate picture of what is under ground at that point, was put down by the Snowden-McSweeny Company, an oil concern, on their own initiative and at their own expense, but in full cooperation with the Geological Survey.

"Of course we cannot tell from a single core drilling how extensive the new beds are," Dr. Mansfield continued. "But we do know definitely now that working quantities of rich potash minerals exist at this place, and our previous work indicates that potash deposits of some sort exist in many places, distributed over an area about three hundred miles long by about half as wide, in eastern New Mexico and the Texas panhandle. We hope to make further core drillings, to obtain a better idea of the extent of the really rich deposits."

The new potash field is well served by railroads. Two lines run through it, and three others have branches into it at various points. Galveston is the nearest saltwater port, but practicable hauls might also carry the product to points on the Mississippi River. Geological Survey officials believe that for certain types of soil, the minerals as they come from the shaft would need only grinding to make them satisfactory fertilizers, but for long hauls probably concentrating treatments would be advisable, in order to save bulk and weight. More or less rock salt occurs in between the layers of potash minerals, but this can be picked out easily by even the cheapest of labor.

The exact geological age of the deposits has not been determined, but they are believed to belong to the Permian period. This was an age of drought that intervened between the Pennsylvania period or "coal age" and the times of the dinosaurs. The beds were probably formed by a series of advances and retreats of an arm of the sea, which formed great saltwater lakes. These dried in the arid climate, just as the Caspian Sea, or on a smaller scale, the saline lakes of the west, are drying up today, and as they did so the various chemicals in solution were precipitated. The less soluble ones, like the compounds of lime and potash, were precipitated first, and the easily soluble common sea-salt only at the end of each drying-out, so that layers of salt now alternate with layers of potash and other minerals.

The following table gives a "log" of the layers of potash minerals as shown by the core drill:

Depth at Which Found	Thickness in Feet	Percent of Potash
990 feet	5 feet 3 inches	14.5
1,135 "	2 " 6 "	14.0
1,225 "	2 " .. "	12.5
1,270 "	5 " 8 "	14.2
1,365 "	3 " 6 "	13.6
1,395 "	3 " .. "	15.1
1,425 "	3 " .. "	9.4
1,445 "	2 " 8 "	16.3
1,570 "	2 " .. "	13.0
1,762 "	3 " .. "	12.1

* * *

Making the Invisible Visible

THE ultra-microscope with bilateral illumination illuminates on all its surfaces the object under examination by means of rays of light converging on it at different incidental angles. Certain of these rays can, at will, be suppressed by convenient manipulation and without having to touch the object under examination.

In addition to this, in order to obtain particularly clear photo-micrographs, the new apparatus, owing to its special construction, can function not only in visible white monochromatic, or in bicolored light, but also in ultra-violet light. These characteristics permit rendering visible objects and particles which otherwise would not be discernible, due, in the case of ultra-violet light, to the greater resolving power conferred by its short wavelength.

The apparatus employed was produced with the co-operation of Nachet, Paris, and is composed of two distinct parts. Of these, the first is a special immersion objective on the inside of which, on the axis, is placed a tiny metallic disk, the reflecting surface of which (8, see elevation drawing) is turned toward the object and sends back to it in a downward direction, such rays (49) as strike it after having traversed the object in an upward direction.

This form of objective constitutes an ultra-microscope with bilateral illumination, thus placing ultra-microscopy at the disposal of those who possess an ordinary microscope with a simple Abbe condenser. The objective in question can also, at will, be supplied with a little external reflector, the Lieberkühn type (45), which sends back toward the object oblique rays (48) and (50), after they have already traversed it.

The second part of the apparatus carries a special condenser whose optical parts are made of fused quartz, and which can therefore be employed just as well with ordinary visible light as with ultra-violet rays. This concentrates on the object under examination two kinds of luminous rays: first, very oblique ones coming from all the azimuths, after reflecting on the surfaces (29) and (28); then, central rays of weak aperture which converge on the object after having traversed the quartz lens (23). All these rays, after having passed the object on its under side, are sent back to the upper surface by the reflectors (8) and (45).

At (38) is a bicolored glass screen which is removable and which gives a very peculiar illumination. This makes visible, in certain colorless objects which have not undergone any sort of chemical staining, selective colorations of different structures. This method may prove useful for studies of living objects where stains are difficult to apply.

At (43) is a little screen which one can push aside from the axis by moving the handle, uncovering the lens (23) at will.

Finally (40) is the iris-screen.

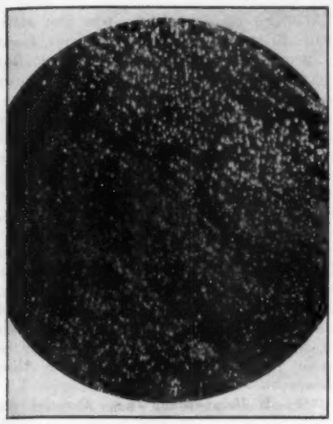
A more detailed study of this apparatus and its functions appeared in the *Archives*

Gold leaf under the eye of the ultra-microscope, magnified 7,000 diameters. The filamentous, granular structure is visible

des Sciences Physiques et Naturelles (Geneva, Switzerland), Fifth Period, Volume 8, pages 121-131.

Let us pass on to some interesting results obtained in photo-micrography with the aid of this new device.

One of the illustrations represents, at a magnification of 2,625 diameters, a very thin sheet of dry collodion apparently as



A dry gelatine sheet, magnified 2,800 diameters. The cloudy appearance at the side indicates fine unresolved particles

clear as the purest glass. It is calculated that a cubic inch of dry collodion contains about six hundred billions of granules.

Another photograph represents, at an enlargement of 5,300 diameters, the central part of the diatom *Pleurosigma angulatum* with all its marvelous structure. A companion photograph shows exactly the same object seen at the same enlargement, but this time illuminated by an ordinary ultra-microscope with a very oblique illumination. In spite of irreproachable focusing, only the two sides of the diatom are illuminated, while the greater part of it remains in darkness. A comparison between those two photographs demonstrates the advantages of bilateral illumination.

A photograph of a dry gelatine sheet having at most a thickness of one 250,000ths of an inch, and enlarged 2,800 diameters, is shown. The gelatine seems to be composed of two sorts of granules; the larger ones are visible on the photograph and have a tendency to form extended linear and parallel chains; the others are not visible because they are probably too small, but they give to the inter-granular space a nebulous or cloudy appearance under ultra-microscopic illumination.

Another photograph represents pure gold leaf, the thickness being at most one 250,000ths of an inch, at an enlargement of 7,000 diameters. It shows the intimate structure of this metal, which seems to be composed of a tangle of irregular filaments, each of which results from the union of several granules. The granules appear to be less than one-tenth micron in diameter. (A micron is a millionth of a meter and is approximately one 25,000ths of an inch.)

By using an ultra-microscope of like characteristics, although not entirely the same, Doctors Gye and Barnard of London claim to have discovered the germ of cancer.

* * *

Better Abrasives

Two interesting advances in the abrasive industry are illustrated by two of the photographs reproduced in these columns.

It is said that the efficiency of abrasive products depends principally on the character of the abrasive particles, that is, their size, shape and strength. Manufacturers of abrasives have long sought to improve these characteristics.

In preparing abrasive powders and grains, masses of fused abrasive are crushed and screened. No matter how carefully this work was done, a certain percentage of weak grains, irregular in shape, long and slivery, are bound to be included.

Recently, however, a new process has been developed for the elimination of these undesirable grains from abrasives. It is said that grinding wheels made of these sorted grains do better work than those which are not. The grains shown in the photo-micrograph have been sorted by this method. They are solid and well-shaped. Those shown in the illustration have been passed through a silk screen having 46 meshes to the inch.

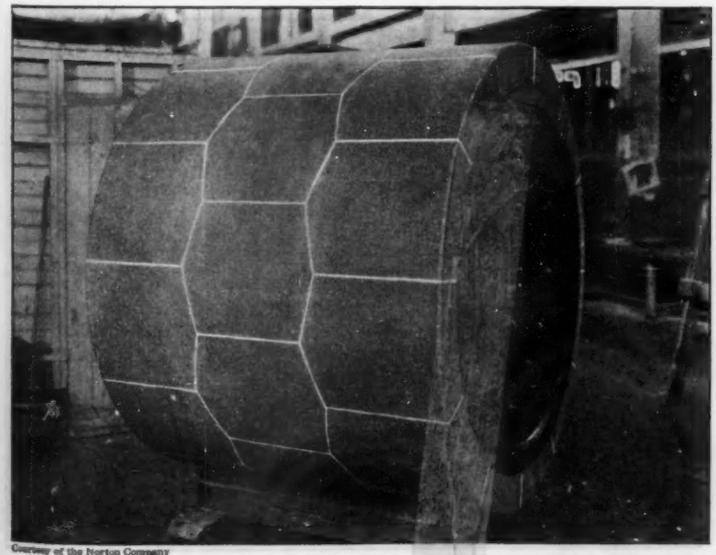
A second advance has to do with the large abrasive wheels that are used for grinding logs into newspaper pulp. Wheels of natural, quarried sandstone have long been in use for this purpose. These, however, were subject to numerous drawbacks due largely to their lack of homogeneity. A new kind of wheel consisting of vitrified segments of the abrasive generically known as silicon carbide, attached to an iron spider has been developed. The one shown in the illustration is 57 inches wide and 67 inches in diameter. The joints between the segments are filled with a special alloy.

It is obvious that this wheel, in which the grain of the abrasive, its distribution and all other factors are wholly controlled by man instead of governed by the vicissitudes of nature, as is the case with quarried sandstone, ought to possess superior qualities.

* * *

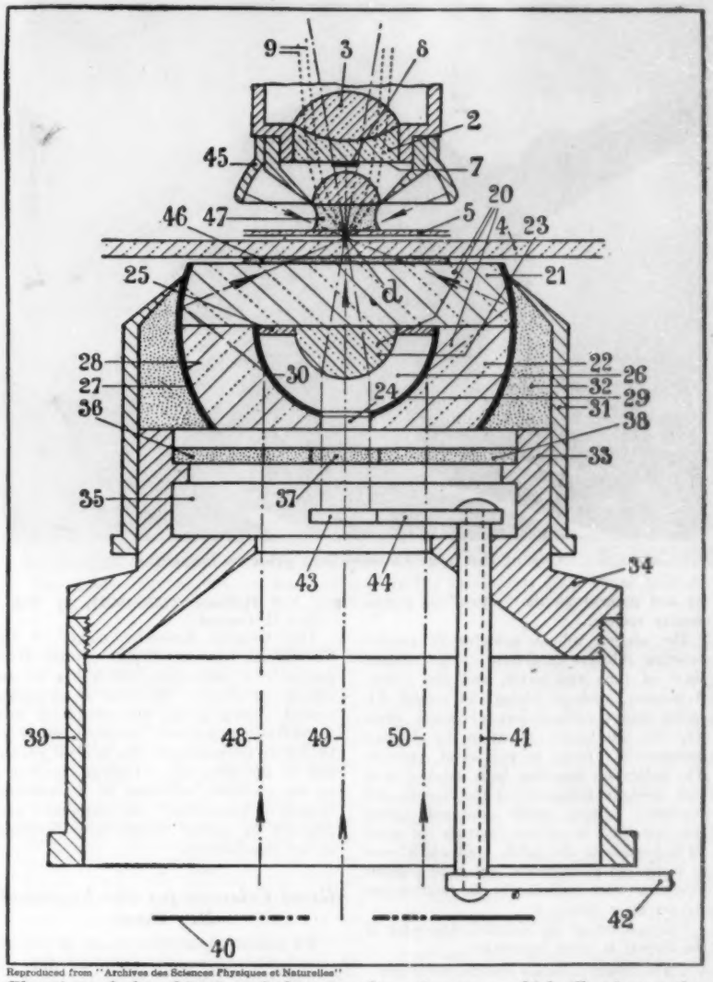
Colored Gasoline Often Best

THE motorist of the future will be able to match the color of his car when he fills his tank, and he will not have to worry about the gasoline supply for some time to come, according to Dr. Gustav Egloff who



Courtesy of the Norton Company

Large artificial-sandstone wheel used for grinding newspaper pulp



Reproduced from "Archives des Sciences Physiques et Naturelles"

Elevation of the objective of the new ultra-microscope which illuminates the examined object from several directions

has investigated the possibilities of getting motor fuels from various sources.

"The potential future gasoline supply will last for hundreds of years," Dr. Egloff said, "and it will come from 'cracking' a wide variety of materials such as petroleum, coal tars, shale oil and wood tars. The old-fashioned gasoline was simply evaporated off the crude oil and had no anti-knock properties. The modern 'cracking process' is a way by which heavy oils are chemically broken down into lighter ones suitable for motor fuels. 'Cracked' gasoline has valuable anti-knock properties, and the gasoline of the future will be a mixture of the two. Motor fuels will yield double the mileage and have anti-knock and easy starting properties."

But the cracking process has not only created new styles in the quality of gasolines, Dr. Egloff explained, but has also introduced a new variety of colors. Although there are still many specifications that require gasoline to be water-white, the automotive cylinder that transforms "gas" into miles has no preference for any particular shade or tint. In fact, color means nothing to the motor. It does, however, mean something to the distiller, for he often tries to doctor up his gasoline to get rid of all trace of color and as a result loses some of the anti-knock properties.

"It is a happy sign to motor over the country and see not only yellow, but pink, red, blue and green as well as water-white gasoline in the visible bowls," Dr. Egloff said. "The motor is no stickler for style. It will operate as well with the yellow as with the water-white, blue, pink, or even red, gasoline. Perhaps some day the motorist will suit the color of the gasoline to the car he uses.

"Not only should the public get used to all sorts of colors in gasoline but to all sorts of odors as well," Dr. Egloff continued. "The cracking process has given motor fuel new odors as well as new colors, and to remove them is a useless waste of labor as well as material."—*Science Service.*

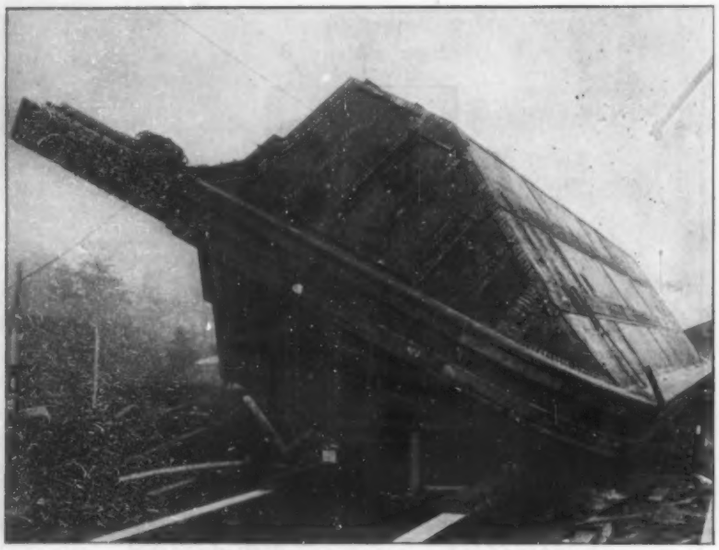
* * *

Good News for the Lover of Science

WHAT inveterate reader of scientific literature does not note with quickened pulse the regular appearance of the Annual Report of the Smithsonian Institution? What a prosaic title for such an engrossing collection of scientific papers! The writer remembers the time when, as a youth, he yearly made life miserable for a certain village librarian until the newly received

Abrasives sorted by new process

report was placed on the shelves ready to be taken home. The Institution's Eightieth Report has now put in its appearance. What a shame that this brilliant collection of scientific papers has to make its way in a world of books, crippled by the title of "Annual Report"—as thrilling in its connotation (to those who do not already know



One of the large caissons just prior to launching

its real nature) as the "report" of a missionary society.

The present volume contains 27 articles covering subjects as diverse as the immensities of time and space, and the potato. Astronomy, geology, biology in several different phases, anthropology, chemistry, physics, are all given attention by leading scientists of Europe as well as of America. The collection contains both original articles specially prepared for the Report, and reprinted articles which appeared during the year 1925 in various journals not readily accessible to the public, and which seem to merit the permanence and wide popular attention which inclusion in the Smithsonian Report gives them.

The content of the General Appendix of the Report is given herewith:

The Spiral Nebulae and the Structure of Space, by Carl Wirtz.
Immensities of Time and Space, by A. Vibert Douglas.
Certain Aspects of High-pressure Research, by P. W. Bridgman.
Lightning and Other High-voltage Phenomena, by F. W. Peek, Jr.
Chemical Elements and Atoms, by G. Urbain.
The Manufacture of Radium, by Camille Matignon.
The Chemistry of Solids, by Cecil H. Desch.
Terrestrial Magnetism in the Twentieth Century, by Daniel L. Hazard.
Some Causes of Volcanic Activity, by Arthur L. Day.
Geology in the Service of Man, by W. W. Watts.
The Yeasts: a Chapter in Microscopical Science, by A. Chaston Chapman.
Tropical Cyclones and the Dispersal of Life from Island to Island in the Pacific, by Stephen Sargent Visher.
Isolation with Segregation as a Factor in Organic Evolution, by David Starr Jordan.
The Biological Action of Light, by Leonard Hill.
Animal Life at High Altitudes, by Major R. W. G. Hingston.
The Nest of the Indian Tailor Bird, by Casey A. Wood.
The Needs of the World as to Entomology, by L. O. Howard.
From an Egg to an Insect, by R. E. Snodgrass.
The Role of Vertebrates in the Control of Insect Pests, by W. L. McAtee.
Carnivorous Butterflies, by Austin H. Clark.
The Potato of Romance and Reality, by W. E. Safford.
The Relation of Geography to Timber Supply, by W. B. Greeley.
The Historical Geography of Early Japan, by Carl Whiting Bishop.
The Excavations of the Sanctuary of Tanit at Carthage, by Byron Khun de Prorok.
The Smithsonian Institution.
Sir Archibald Geikie, by Sir Archibald Strahan.
Ned Hollister (1876-1924), by Wilfred H. Osgood.

This General Appendix makes of the Smithsonian Annual Report (price $1.50, postpaid) a publication which has no duplicate anywhere. The idea of preparing annual reports giving an account of new discoveries in science "prepared so as to be highly interesting to the general reader, and at the same time of great importance to the exclusive cultivator of a particular branch of knowledge," was introduced into America by Joseph Henry, first Secretary of the Smithsonian.

* * *

Great Caissons for the Esquimalt Dry Dock

WE present illustrations of one of two big steel caissons recently built for the six-million-dollar government graving dock—at Esquimalt Harbor, B. C. Because the dock is divided into sections, two gates are required instead of the customary single gate. By having the dock in sections, the whole of it does not have to be pumped out for a small ship, and two vessels can dock and leave independently of each other. The caissons have similar dimensions except as to height—the length being 138 feet 6 inches, the beam 27 feet, and the height of one being 46 feet and of the other 49 feet.

Owing to the limited depth of water for the launching, they were built and launched, not in an upright position, but on an angle of 30 degrees as shown in the accompanying illustrations. Both caissons were built by Yarrows, Ltd., of Esquimalt. The larger of the two was the first to be constructed. The launching weight was 715 tons, and when in the water it floated with a list of 23 degrees. Five hundred tons of concrete ballast is carried in the lower sections between the two end bulkheads for purposes of stability.

Each caisson has a total of six decks. The amount of steel in each caisson is about 1,875,000 pounds, and the thickness of the shell plates is $\frac{5}{8}$ inches and $\frac{3}{4}$ inches, and of the decks $\frac{1}{2}$ inch. The entire exterior and interior steel surfaces are protected with an application of bituminous solution and enamel, the latter being applied hot in the usual manner. The total weight of each caisson in complete condition is 1,500 tons. The draft in light condition is 28 feet 6 inches, and when flooded, the submerged draft is 45 feet 6 inches in the case of the 49-foot gate and 42 feet 6 inches for the 46-foot gate.

When the dock is to be used, the gate is floated into position with its keel, and the stern at each end resting against offsets in the side walls and floor of the dock. As the water is pumped out of the dock, the pressure of the water outside brings the keel and ends of the dock into close contact with these offsets—the pressure increasing until, when the dock is empty, the caisson has to withstand a total water pressure of 4,700 tons. In order to secure a watertight contact, the side of the keel and stems is fitted with Australian iron bark five inches in thickness and 24 inches wide. This wood, among its other qualifications, is impervious to the attack of the teredo—a marine insect which attacks wood on the Pacific Coast with destructive effect. No less than 20 tons of this iron bark is required for each gate.

The caissons are each equipped with two centrifugal pumps of 1,600 gallons per minute capacity—the suctions being carried into a sump in the concrete ballast at the bottom of the gate. The pumps, electrically driven, are located on number two deck. On the same deck are installed the inclinometer and depth gage, together with the necessary controls for the motors, and the hand wheels for controlling the flooding valves below. These flooding valves are so located that by their manipulation, a fore-and-aft trim can be maintained when sinking the gate into position. The graving dock is 1,150 feet in length and 149 feet in width. The depth of water over the sill at high tide is 40 feet. This great dock, which at high tide contains 43,000,000 gallons of water, can be emptied by its electrically operated pumping plant in three and one-half hours.

* * *

Electricity from Light

SCIENTISTS may harness the sun when they know more about photoelectricity, the principle governing radio, Dr. Herbert E. Ives of the Bell Telephone Laboratories, New York, declares in a research report to the Engineering Foundation.

"May we look to photoelectricity for direct conversion of the sun's radiation into electrical energy for industrial purposes?" asks Dr. Ives. "As yet, efficiency is so low as to offer no immediate promise.

"It is probable that the utilization of the sun's radiated energy by vegetation is primarily induced by photoelectric response. We may, by advancement in knowledge of photoelectricity, master ultimately the utilization of solar radiation, though we may have to resort to the indirect method of nature."

Heinrich Hertz laid the foundations of modern radio, according to Mr. Ives. "Hertz produced electromagnetic waves by causing sparks to pass between separated metal electrodes in air," he explains.

"In 1887, he observed curious irregularities. With all electrical conditions the same, the sparks would sometimes pass easily, at other times not at all. This behavior excited his curiosity. He sought for its cause, and discovered that when light was falling on the electrodes the sparks passed most easily.

"Ultra-violet light, such as the light from another spark, was most effective, as shown by the great decrease in influence when a clear plate of glass was interposed.

"Other experimenters soon found that the effect of light on a metal electrode was to make it acquire a positive charge, or lose a negative charge. Later, after J. J. Thomson had discovered the electron, it became clear that when a metal is illuminated it gives off electrons.

"Lenard, pupil of Hertz, who first systematically studied photoelectric effects, found a peculiar characteristic of the emitted electrons, which has kept the greatest minds in physics guessing.

"He found that the number of electrons emitted was porportional to intensity of illumination, as one would expect, but the energy with which they were emitted was quite independent of the intensity of the light, depending merely on its frequency, or color.

"Whether we get our light from an arc lamp a foot away, or from a candle a mile away, or from a star ten light-years away, the electrons shoot out from the illuminated surface with the same initial energy—that is, the metal plate must be charged to the same positive potential to prevent their escape.

"Sir William Bragg has pictured the phenomenon as follows: Suppose a plank dropped from a ship at sea. Waves would spread outward, ever diminishing in height. Another ship would intercept a minute section of the wave front. Instantly a plank would be exploded from the side of this ship, and fly to the height from which the original plank fell.

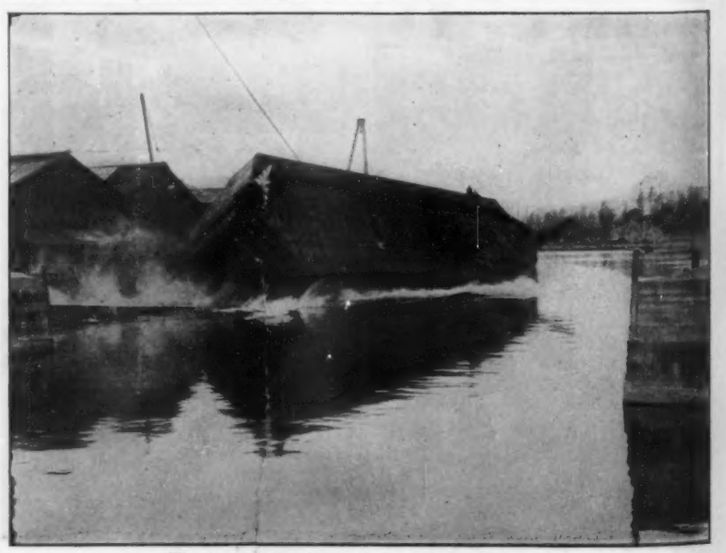
"To explain this extraordinary effect, Einstein formulated his first revolutionary physical theory, of light quanta. Light, said Einstein, consists not of electromagnetic waves in the ether of uniform intensity along their whole fronts, but of bundles of energy. The wave front is 'speckled.'

"This quantum is the same quantum of energy turning up wherever radiation and matter interact. There is no doubt of its reality, and of its importance in the explanation of the physical universe.

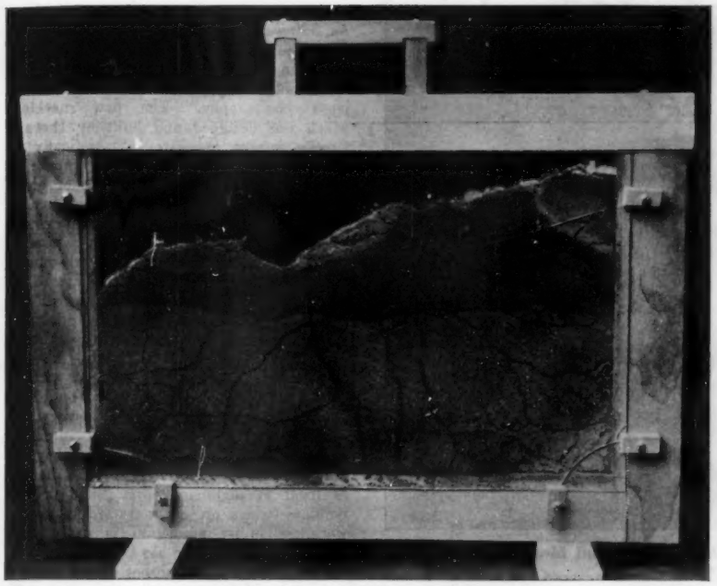
"Practical applications center around the development of highly sensitive photoelectric cells. Best conditions are obtained by putting the metal in a glass or quartz enclosure, and controlling both the kind of atmosphere and its pressure.

"The typical photoelectric cell is a glass bulb, with one electrode, the cathode, usually a layer of alkali metal on the inner surface, with a wire leading out through the glass, and another electrode, the anode, a loop of wire, likewise carried out.

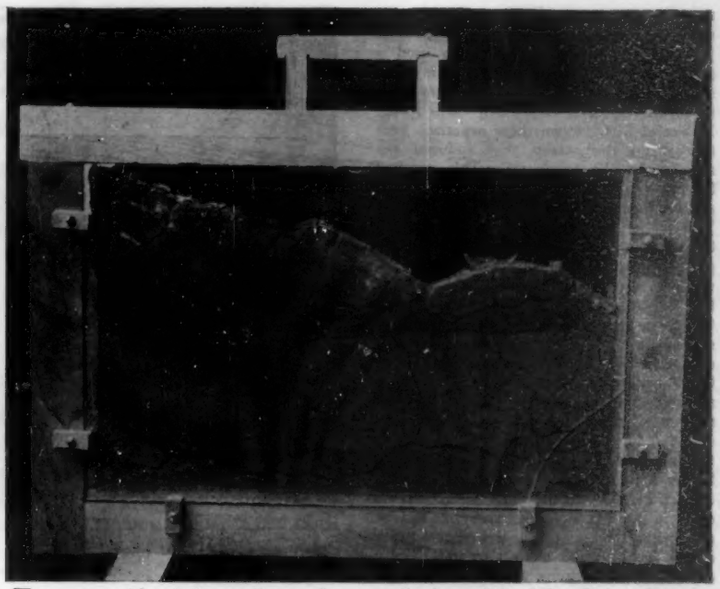
"Connect these two wires through a galvanometer and let light shine in the bulb; the galvanometer will show electric current flowing. The current starts and stops instantaneously; it is proportional to the illumination.



The launched caisson just entering the water



Tunnels made by ants confined in a simple portable ant house constructed of wood and glass and filled with sand. The lines are the tunnels



The reverse side of the ant house shown at the immediate left. It is only one-half inch thick and permits the study of habits of ants

"It is quite small, but with proper instruments, it may be used to measure light from such faint objects as sixth magnitude stars. In electrical transmission of pictures, photoelectric cells do exactly what is required. They transform the light and shade of a picture, as traced by a tiny beam of light, into an electric current, varying exactly with the picture values, and without lag or distortion.

"To be used, some means had to be found to increase the minute photoelectric currents for transmission over telephone or other lines. This has in recent years been made possible by development of the thermionic vacuum tube."

* * *

A Portable Ant House

ANTS may be studied in their daily lives without the necessity of going out of doors and crawling around on the ground. By making a small "ant house" consisting of two panes of common window glass attached to opposite sides of a simple wooden frame, one can see the actions of these interesting insects right in one's home. The ants cannot become a nuisance because they cannot get out of their transparent prison cell.

The first picture shows one side of the interior of an ant home just as the ants arranged it. The home, consisting of rooms, tunnels and galleries, is being constructed by a colony of ordinary small brown ants, such as make the tiny circular mounds of sand around a small entrance hole in your dooryards. The enclosure itself was designed and made by Professor F. E. Austin, of Hanover, New Hampshire.

The ants, consisting of about 30 workers and a queen, were placed in the ant house one day last August, and within five minutes the workers had started to excavate at the opening seen at the right center, which they enlarged into a chamber for their queen in a few days.

During the first week, the ants worked all day and all night with tremendous activity, and on several occasions the queen, being unable to squeeze her large body through the preliminary tunnels, was observed to seize hold of sand grains much too large and heavy for the ordinary workers to lift and carry them up and deposit them on the surface outside. Queens sometimes unbend and perform useful labor, in the ant world.

The queen of the small brown ant family is about the size of a common large black ant, and the queen in this particular colony has no wings. At present the queen spends the greater portion of her time in the large room or chamber, and has done no transporting of material since the chamber was sufficiently enlarged for her convenience.

Since completing the queen chamber, the ants have worked very leisurely, but, as may be seen, they are constantly making long new tunnels with numerous short connecting galleries. Later on, they will doubtless arrange the larvae and pupae in these, in an endeavor to perpetuate the colony.

The ants first make the long tunnels small in diameter and gradually enlarge them throughout their length later on.

Science teachers who are employing these ant houses for observational studies in schools have named them "Totems" because the small and self-contained ant world may be easily "toted" about by anyone. They may be allowed sanctuary in the living room or in the nursery with complete assurance that no degenerate ant will break out and commit depredations in the family sugar bowl.

There are a number of surface entrances to the network of tunnels. This leads to the inference that what appears in our dooryards to be a single ant hill may be only one of the numerous entrances to a quite extensive ant home. Numerous exits also help ventilation and insure against accidental closure of the whole system.

The second picture shows the arrangement of tunnels and rooms in the other side of the same ant house. The two panes of ordinary window glass that constitute the sides of the ant house are sixteen inches long and nine inches wide, and are so arranged in the supporting framework that they are parallel with each other and about one-half inch apart. The arrangement of the tunnels is different on one side than on the other, and another queen chamber is being constructed or excavated on the side shown in the second photograph. The queen occasionally spends a time in this chamber.

Some of the vertical tunnels are being excavated upward instead of from the top downward. Obviously this must require much more labor and a longer time to excavate, for all the material must first be carried down the tunnel and then up some other tunnel to the surface. Several of the longer, vertical tunnels were thus excavated from below upward. This fact would undoubtedly greatly please Mark Twain, who has recorded (Chapter XXII, Volume I, of "A Tramp Abroad") some of his observations pertaining to ants while they were motivated by brainstorms. The record proves that Mark was a keen observer and that ants have brains.

* * *

Antiseptics Not Always Antiseptic

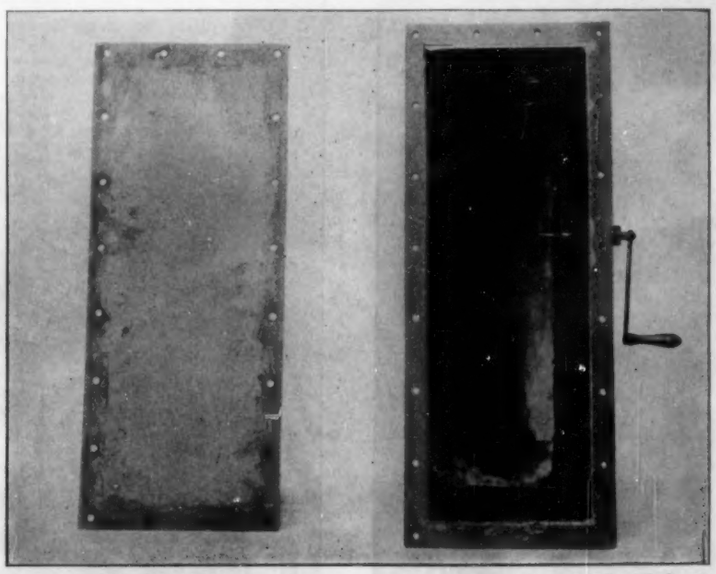
WILL we shortly be riding into the operating room for our appendicitis operation with our "tummies" painted pink or purple instead of with the commonplace familiar brown of iodine? Medical investigators have decided that the average antiseptics used in hospitals leave much to be desired in germ-killing capacity and after extended research have found that some of the aniline dyes give almost 100 percent results in obtaining a really sterile skin.

Search for an explanation for the occurrence of occasional cases of septic poisoning in apparently clean wounds has led Drs. Martin B. Tinker and Henry B. Sutton of Ithaca, New York, to make a detailed investigation of germicides and antiseptics in current use in some of the best organized hospitals.

"Laboratory studies," say the Ithaca doctors, in a report of their results to the American Medical Association, "have indicated the inefficiency of iodine, the most widely used of the inefficient antiseptics.

"Personal study of more than 1,550 cultures, results in most instances confirmed by others, have demonstrated that iodine, trinitrophenol, mercuric-chloride solution, mercurochrome-220 soluble, and potassium mercuric iodide will not kill most of the resistant, and some of the less resistant, pathogenic bacteria under conditions of perfect contact, and are still less efficient if penetration is required.

"The aniline dyes seem to deserve further investigation and probably wider use on the basis of apparent germicidal power, penetration, low toxicity, harmlessness to instruments and supplies, and excellent outlining in the field."—*Science Service.*



Interior of the case of a submarine motion-picture camera invented by Dr. Paul Bartsch, of the Smithsonian Institution. The lens aperture shows faintly at the upper end of the camera box, whose cover shows at the left

* * *

Movie Camera for Use on Sea Bottom

A MOTION-PICTURE camera completely equipped to be set up on the floor of the sea and record ocean life as simply and accurately as if it were the dry land has left the Smithsonian Institution to be tried out at the Marine Biological Station of the Carnegie Institution at the Torgugas. Dr. Paul Bartsch, curator of mollusks in the National Museum under the Smithsonian, who fathered the adaptation of the camera to undersea work, will operate the instrument. It was constructed under his direction by Mr. Andrew Kramer, instrument maker of the Smithsonian Institution.

This new submarine camera solves the problem of focusing and cranking, while remaining water tight, so ingeniously that any one accustomed to ordinary motion-picture photography can operate it beneath the waves. It is set up on a tripod, can be tilted, used for a panoramic view, can be turned slowly or fast, and can be focused as readily as on land. In addition, it carries a load of 400 feet of film. In all these particulars, it is a great improvement over

the other cameras previously used under the sea by Dr. Bartsch.

Beginning in 1922, Dr. Bartsch used a small camera which he held in his hand and which could not be focused, nor have its speed regulated and which carried only 16 feet of film. When these negatives were thrown on the screen they induced sea sickness in the spectators. This resulted from the swaying of Dr. Bartsch's body by the water currents while holding the camera. The use of a tripod ended this difficulty. Other drawbacks have been overcome in the present improved instrument, the casing of which is illustrated at the bottom of page 127.

Hitherto all submarine photography has required a cumbersome mechanical outfit so expensive as to make it almost prohibitive. Dr. Bartsch requires nothing but a launch and a man to pump air to him. He wears a diver's helmet, but otherwise is clothed as on land. Last year he oiled his body with olive oil and found that he could spend five and a half hours under water without discomfort. By not using a complete diver's costume he has much greater freedom of movement. He has photographed at a depth of 35 feet, but he ordinarily works in a depth of ten or twelve feet.

Quite apart from the educational importance of the secrets which this new invention will reveal to mankind, it has a great scientific value, one phase of which can be mentioned. It reveals the faunal associations under the sea. Thus scientists can learn what groups of life gather together and under what conditions of temperature, salinity and so on. This information gives them the key to the conditions in which fossil marine animals lived and will be of great assistance in correcting geologic time.

* * *

"Ultra-slow" Motion Pictures Show Plant Growth

ONE of the primary functions of the United States Department of Agriculture is to disseminate information gathered, and in many cases discovered, by its many ramifications. This function uses the energies of a division known as the Extension Service, which in turn is divided into subsidiary offices, each specializing in some particular method of getting information efficiently to the spot where it will do the most good.

The Office of Motion Pictures, a division of the Extension Service, not only puts facts into photographic form but frequently photographs the proofs. This office brings into play practically the whole range of the motion picture art, aiming not only to present facts, but to present them interestingly. In many cases what would otherwise be a film lecture is metamorphosed into a human interest story with plot, counterplot, drama, comedy and climax, so that it can be, and is, enjoyed. Such a film may include, besides "straight" photography, cartoons, scientific animation, slow motion, trick work and microscopy. Because of the wide range of its work this department is housed in a building constructed especially to meet its needs, having facilities for doing everything from making negatives to screening the finished picture.

Wide World

Taking "slowed-up" motion pictures of the progress and blossoming of plants grown under artificial light

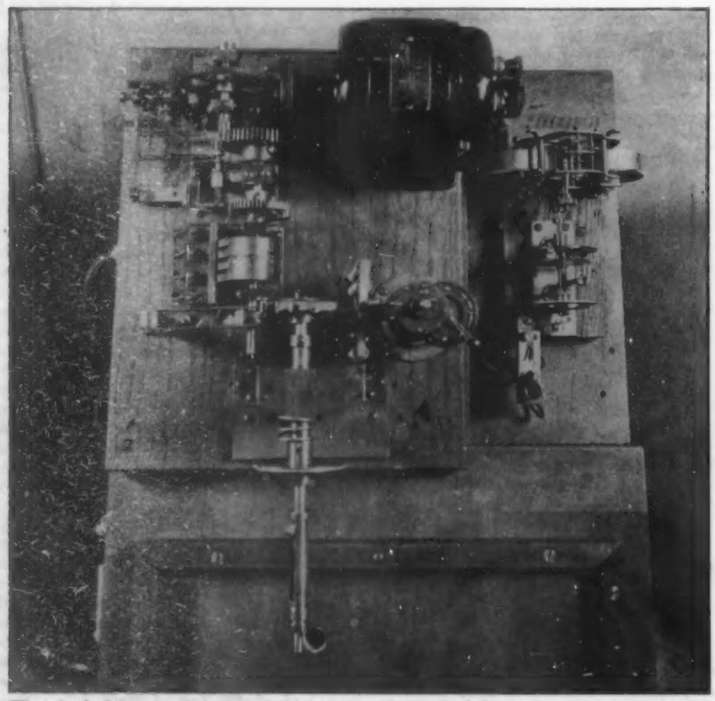
Not only does this office produce films including many kinds of motion picture photography, but it designs and builds, when necessary, whatever apparatus may be required for special purposes. Often it is difficult, or quite impossible, to purchase just what is required, and when the work involves more or less experimenting it is more satisfactory to carry it on where practical working tests can be made from time to time and changes or improvements can be made on the spot. The most recent of these experimental devices is called, for want of a better name, a "time-lapse machine." Its function is to make motion pictures of objects which have movement so slow as to be imperceptible to the eye, such as the growth of plants, the development of plant diseases, or larvae, mould growth on fruits, and so on. A familiar example of this type of photography is the opening of a flower.

The work of the time-lapse camera is the exact opposite of that of the ultra-speed camera. Where the latter makes film which slows down high speed, the former makes pictures which speed up slow motion. Such film is made by exposing one "frame" (the motion picture man's designation for one of the little pictures making up a film) at a time, at comparatively long intervals. The slower the growth or other movement of the subject, the longer the intervals. If the intervals are too short there will be so little movement between exposures that when the film is printed and projected the action will be slow and long drawn out. If the intervals are too long the action will be too rapid, and there may even be perceptible jumps, instead of smooth continuous motion, as the picture is projected.

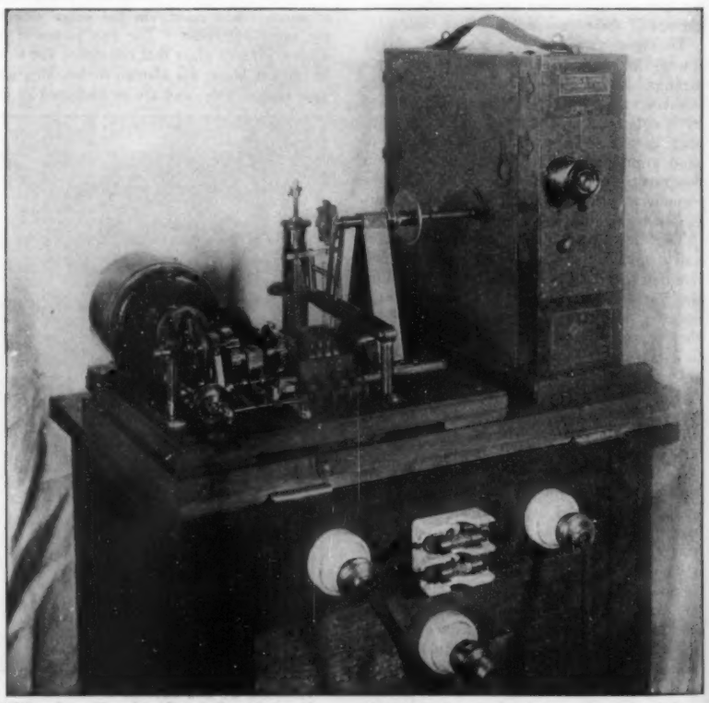
Motion pictures of this type have been made by hand-cranking one frame at a time. As, however, it often is necessary to "shoot" continuously for several days and nights, and even for a week or more, it is obvious that hand-cranking has limitations for time-lapse photography. The new machine, which was designed and built by Howard Greene, makes exposures automatically at any desired interval, from half a minute to an hour, and by changing a pair of gears the range can be increased to two hours. One hour, however, is more than enough for almost any work. Above one minute, the settings can be varied in one-minute steps, and to make a change in interval it is necessary only to turn one disc, which can be done while the machine is at work without in the least affecting its operation. In addition to making the exposure, the machine controls two mercury-vapor lights. These are automatically switched on about 20 seconds before the exposure, so they will have ample time to reach full intensity. Immediately the shutter has closed they are switched off. As the machine must be left to itself at night and over Sundays and holidays when on a protracted piece of work, reliability of action is exceedingly important. No trouble has been experienced in this respect. Not a shot was missed in a test run of five weeks.

Time control is vested in a double-spring movement operating a small but efficient mercury switch in the circuit of the motor which does the actual work. The motor drives the camera-operating mechanism and the rotary switch handling the lights. It runs for about 40 seconds at a time, the circuit being open when no work is done.

Used for investigation and study, the time-lapse machine promises to be of no little value as a means of analyzing growth and studying characteristics that would otherwise remain unseen and unknown. The machine will keep vigil day and night and make a faithful and accurate record of what occurs. The exact time of any given action of the subject can be ascertained by simply measuring the length of film, or a watch can be placed in the field so that the film will show the exact time of each exposure. Temperature can be similarly recorded. Already interesting questions have been raised concerning the "plant instinct" that apparently causes a flower, cut off from its source of natural light and photographed entirely by artificial illumination, to close its petals at night. Investigation of this is under way, using the time-lapse motion picture camera.



The clock-driven switch starts the small motor and stops it at the correct intervals. The motor drives the camera, through a train of gears



This new slow-motion picture camera makes single exposures at any predetermined interval. The controlling mechanism is shown at the left

In the World of Chemistry

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Conducted by D. H. Killeffer

Fuel Problems

ATTENTION was focused upon the possibilities of utilizing soft coal as a raw material from which to obtain liquid fuels for internal combustion engines by an International Conference on Bituminous Coal held recently at the Carnegie Institute of Technology in Pittsburgh. The reports broadcast from this conference left readers of the daily press with a somewhat confused impression that soft coal had already solved the vexing problem of the motor fuel of the future.

The Federal Oil Conservation Board, appointed by President Coolidge to study the situation, had previously reported that our national petroleum reserves fall short of the optimistic views frequently expressed by petroleum experts and that there is an actual probability of a petroleum famine in the not far distant future. In the light of this report of the oil situation, the activities of chemists in converting solid to liquid fuels become increasingly important, but it must be borne in mind that neither the oil famine nor the practical preventive for it has yet become a reality. Much, however, has been accomplished and although conditions in this country have not yet reached a point where substitutes for petroleum are required commercially there is much foundation for the hope that the approach of an oil famine will not find us unprepared.

At the Pittsburgh conference, three possible methods of converting soft coal to liquid fuel were suggested and discussed as offering promise. The first and most obvious of these consists of the distillation of coal by what is called the low-temperature process; the second consists of the liquefaction of the coal by the Bergius process of hydrogenation and the third process converts solid coal to gas and from the gas prepares a liquid fuel. The low-temperature process is already being used in this country and abroad and the other two processes are in a semi-commercial state abroad.

In the distillation of coal, the higher the temperature, the larger the amount of gas produced and the smaller the amount of tar. In ordinary gas practice the gas is the thing wanted and so the temperature to which the coal is heated (in closed retorts from which air is excluded) is as high as practicable. In the manufacture of coke a similar high temperature produces a coke of the quality desired by the metallurgists and the tar which might be produced is not wanted.

However, the possibility of obtaining fuels from the tar has been an incentive for many investigators to study the effect of using a much lower temperature. The process used is essentially the same and consists of charging soft coal into closed retorts and heating it to drive off its volatile constituents, leaving a kind of coke in the retort. The gases driven off are cooled to condense the liquid tar which may be later distilled to yield materials which will serve some of the purposes of those derived from petroleum.

The similarity of the two processes ends at about this point, for the use of a low-temperature increases the amount of tar produced and changes its character as well as that of the coke remaining in the retort. Distillations of coal carried out at temperatures considerably above 1200 degrees, Fahrenheit, are ordinarily considered high-temperature distillations and yield 15 to 20 gallons of tar per ton of coal. Low-temperature distillations, carried out considerably below this temperature, yield as much as 30 to 40 gallons of tar per ton and a coke which more nearly resembles a semi-anthracite coal. The problem of low-temperature distillation involves both the utilization of the tar produced and the finding of a suitable market for this coke. The coke may find profitable use as a smokeless domestic fuel.

The Bergius process, for which Dr. Frederich Bergius of Heidelberg is responsible, undertakes to convert solid fuel in finely divided form into a petroleum-like tar by treating it with hydrogen under pressure in the presence of a catalyst. Dr. Bergius' reasoning is based upon the fact that normal bituminous coal contains 16 times as much carbon as it does hydrogen, while liquid oil has a carbon to hydrogen ratio of approximately eight to one.

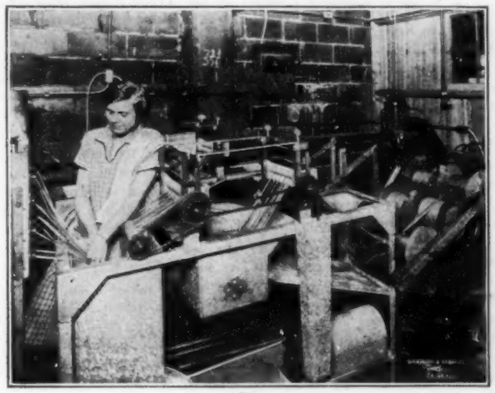
By forcing hydrogen to combine with the carbon compounds in coal, Dr. Bergius has succeeded in converting a short ton of coal into 107 to 185 gallons of an oil somewhat resembling petroleum and capable of being distilled into a number of valuable products, among which are gasoline and fuel oil. The temperatures employed are around 400 to 500 degrees, Centigrade, and the pressures, about 200 atmospheres. Both ammonia and gaseous fuels are obtained from the process as by-products, but no coke. In Germany commercial development of the process is proceeding rapidly, particularly in view of the fact that low-grade coals, such as lignite, may be converted by it into valuable oil.

The process developed in Germany by Dr. Franz Fischer consists first in converting coke, which may be made from low-grade coals with the recovery of valuable tar, into water gas which is then converted into hydrocarbons and other compounds to serve as light, liquid fuels. Water gas is made by treating very hot coke with steam and consists of a mixture of hydrogen and carbon monoxide. This mixture of hydrogen and carbon monoxide is enriched by the addition of hydrogen and is then heated under great pressure in the presence of a catalyst. Under these conditions a variety of compounds containing hydrogen, carbon and oxygen are formed. The character of the catalyst as well as the relative proportions of the two gases originally present control the character of the product and it is possible by proper selection to produce from coke in this way a material having many of the properties of gasoline. All the carbonaceous matter of the coal is converted to liquid fuel by this process.

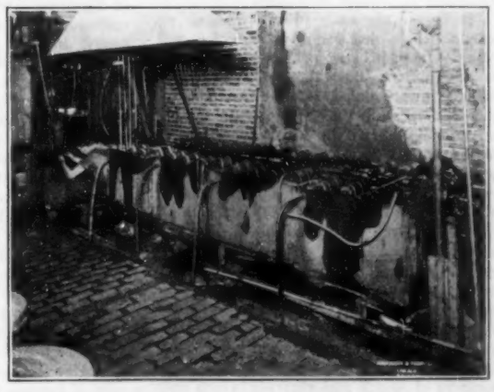
Cellulose for Sausage Casings

EVERY little while someone makes the assertion that synthetic materials are much better for some purposes than the products which they replace. A proof of this statement has recently been brought out by William F. Henderson and Harold E. Dietrich of the Mellon Institute of Industrial Research, Pittsburgh, who have succeeded in making satisfactory sausage casings by a process identical, except in detail, with that used in the manufacture of rayon. Fancy using a silk substitute as a casing for a hot dog!

These two investigators have developed a machine for extruding viscose in the form of sausage casings which bids fair to replace animal intestines for this purpose. The viscose solution is made in very much the same way as that used for making silk. The difference in the process is merely that the sausage casing is extruded through an annular opening instead of a very small, smooth hole such as is used for making silk. The raw material is purified cotton linters and the finished product is a practically pure cellulose.



At the left: feeding the cellulose sausage casings through a glycerol bath and into a pneumatic drier. Casings made by the new process described in this department are wholesome, clean and cheap to make. Chemically, the finished casings are very similar to artificial silk or rayon. As the author says, "Fancy using a silk substitute as a casing for a hot dog!" Soon we may be buying them in different colors



The machine illustrated at the right is of the duplex extrusion type. The photograph also shows the precipitating baths, regenerating baths, wash tubs and a winding device. It may be seen from this that the finished casings should be very clean indeed, and, in fact, this is one of the points stressed by the two research men who collaborated on the questions involved in the production of these new sausage casings

In summing up the advantages of their cellulose casings over intestinal casings, the investigators, in *Industrial and Engineering Chemistry*, make the following points:

"(a) The casings are clean and unquestionably satisfactory from every hygienic or sanitary standpoint.

"(b) They are not subject to rapid putrefaction as are animal casings.

"(c) The casings can be made in any desired size and can be made uniform in that size. The strands can be made any length.

"(d) The cellulose casings are received by the packer in a dry condition, ready for use, and therefore the preliminary preparation of casings as carried on at present in the packing house is eliminated.

"(e) Stuffing can be done more rapidly than with animal casings.

"(f) The sausages packed in cellulose casings are perfectly comestible, may be cooked in any manner, and eaten with no difficulty."

Furfural for Tree Wounds

FURFURAL, a comparatively new commercial product, is now being used in considerable quantities for the treatment of wounds in trees and it is interesting to note that an accident led to its use for this purpose. It is manufactured from the hulls that are removed in preparing oatmeal, and during the early experiments leading to large quantity production several barrels of furfural were stored in the cellar of the plant. This furfural was in new oak barrels and when it was wanted a number of weeks later, everyone was surprised to find the barrels completely empty, although no sign of leakage could be found.

The experiment was repeated, using other new barrels, but the furfural continued to disappear. The final solution of the mystery was that oak is quite permeable to furfural, and hence it was decided to try it as a disinfectant for wounds in trees in order to avoid the labor involved in removing all of the rotted wood. Not only did the furfural penetrate perfectly but it was sufficiently toxic to the fungi living in the wood to prevent their further growth. The advantage of this method of treating tree wounds over the use of hot tar is that the latter refuses to penetrate the wood and this makes careful preparation of the cavity essential.

In addition to this use, furfural is becoming increasingly valuable in the manufacture of many important industrial materials such as synthetic resins, as a solvent in shoe polishes and leather dressings, and as a fly repellant. In the hands of the organic chemist it yields a great variety of compounds, some of which are perfumes, dyes and solvents. As short a time ago as 1921 it was difficult to buy even single pounds of furfural at prices as high as 30 dollars per pound, but now the use of waste oat hulls for its manufacture on a large scale as uses have been found for it have made it easily available in quantities of fifty to sixty thousand pounds as cheap as 15 cents a pound. The present rapid progress of industrial chemistry based on experiments made and forgotten years ago—furfural was discovered first nearly 100 years ago—is admirably illustrated by the rapid development of furfural as an industrial raw material.

Helium Underseas

HELIUM, so prominent during the war and since as a lifting gas for balloons and dirigibles, is finding an important use in reducing the hazard of deep-sea diving and caisson work. A synthetic atmosphere in which helium takes the place of the nitrogen of the air reduces the liability of workers to caisson sickness or "bends" when they come out from the high-pressure atmosphere in which they work. In discussing this new development in an editorial in *Industrial and Engineering Chemistry*, H. E. Howe says:

"Discussions have centered to such an extent about the use of helium in balloons that it is something of a surprise to find it important in undersea explorations. Deep-sea divers follow an occupation made more hazardous by the absorption of nitrogen by their bodies while working under pressure.

Nitrogen exists in the blood and body tissues in simple solution, and the amount that will be dissolved depends upon barometric pressure, temperature, and the coefficient of solution of the gas.

"When a diver has been exposed to an atmosphere at high barometric pressure for some time and this pressure is subsequently released, bubbles will form in the tissues and blood vessels unless sufficient time at gradually reduced pressures is afforded for the gas to escape quietly into the blood and thence from the lungs. This difficulty is called caisson sickness or 'bends.' The bubbles are most dangerous if formed in the spinal cord and brain, causing paralysis or death, and the control of decompression to prevent the formation of bubbles is one of the most difficult problems in caisson and diving work.

"The cooperative experimental work carried on by the Navy, United States Public Health Service, and the Bureau of Mines, has shown that by replacing the nitrogen of the air with helium and also reducing the oxygen content below that of normal air, a synthetic atmosphere can be made that will permit decompression in one-third to one-fourth the time required for air, and that the deleterious effects from nitrogen poisoning can be prevented.

"The advantages of helium are that it is only about half as soluble as nitrogen, thereby greatly reducing the amount of excess gas that a man will accumulate under pressure, and also, because of its smaller molecule, it will diffuse more rapidly than nitrogen and hence facilitate the escape of the gas.

"The first notable work in which this synthetic atmosphere was used was in salvaging the hull of the United States submarine *S-51*. The possibilities of using the synthetic atmosphere of helium and oxygen during the entire period divers are under pressure would be almost unlimited but for the high cost of helium, and instead of an hour on the bottom at 135 feet, nearly two hours could be spent without increase in hazard. Work could also be done at greater depths, making possible the salvaging of many wrecks now beyond reach.

"Helium, which sprang into prominence as a result of the war, like many other war babies, has now grown up to do useful work in a world of peace."

Thallium as an Insecticide

IN a communication recently published in *Science*, C. H. Popenoe of the Bureau of Entomology, United States Department of Agriculture, reports that compounds of the rare metal, thallium, are especially effective in destroying ants. While Mr. Popenoe points out that the price of thallium is now so high that it is impracticable at present, the commercial development of so many other rare materials in the recent past has followed closely on the discovery of some important use for them that it is not impossible that the same thing may occur with thallium.

In his communication, Mr. Popenoe said: "The remarkable properties of the metal thallium and its salts have recently been the subject of considerable research among biochemical workers, and thallium sulfate has attained some commercial use as a poison for rodents, both in this country and Europe. . . .

"Experiments undertaken in a small way during the past spring and summer indicate that thallium sulfate has a limited field in the control of house ants. The small red ant *(Monomorium pharaonis L.)*, a species which arsenic sirups fail to control, has been exterminated in a number of houses and apartments within periods of three weeks to a month by the application of a sirup consisting of one pint of water, one pound of sugar, 27 grains of thallium sulfate and three ounces of honey, the whole being brought to a boil and thoroughly stirred. The ants continue to consume this sirup until the entire colony is destroyed, the thallium appearing to act as a slow cumulative poison, the effects of which are apparent in observable colonies by the considerable numbers of dead queens, larvae and workers discarded daily. The pavement ant *(Tetramorium cespitum L.)* is even more readily controlled, while several other species have shown themselves susceptible."

Increasing Human Efficiency

MOST people are inclined to consider the newer knowledge of nutrition gained through careful chemical research to be in the class of fads and of little practical importance, but when so eminent an authority as Professor H. C. Sherman of Columbia University is willing to prophesy a much more efficient human race by the application of the findings of food chemists to diet, one must take note.

Professor Sherman, in an article in *Industrial and Engineering Chemistry*, recently stated that the experimental evidence gathered from feeding rats over periods equivalent to 600 years of experience in human history point definitely to a lengthening of useful human life and increased human efficiency. Not only did Professor Sherman succeed in bringing his rats to maturity earlier but in the same individual he was able to postpone old age by improving on a diet already believed to be adequate. Professor Sherman believes that these results can be easily reproduced in the human race and says:

"Evidences of higher health through improved nutrition owing to the betterment of a food supply already adequate have been studied statistically in sufficiently large numbers of cases to establish with certainty the fact that all these differences are real and due to the improvement in diet—that they cannot be accidental nor due to chance or physiological variability of the animals. Moreover, the improvements are even more noticeable in the second generation than the first.

"There is no reason to doubt and every reason confidently to believe that all these findings, in the general terms here stated, will apply equally in human experience and that longer life with a higher degree of health will follow an improvement in the dietary of an individual or the food supply of a community, even where the original dietary or food supply was already adequate according to current standards.

"It is yet too early to say whether we should expect that improved nutrition will result in human beings of superior efficiency to any hitherto known. Until the experimental investigation has been carried further and there has been more time for observation of human experience in the light of the newer knowledge of nutrition, we may well hesitate to predict advances over the most illustrious cases of individual efficiency. We may, however, expect with entire confidence that the average of health and efficiency, and the health and efficiency of the great majority of individuals, will be greatly advanced through the application of the new knowledge of foods and nutrition gained through the chemical research of recent years, and that this will bring to a much larger proportion of all people that full measure of health and efficiency which only the most fortunate now enjoy."

Zirconium Replacing Tin in Ceramics

COMPOUNDS of tin have long been used in rendering ceramic glazes on pottery white and opaque, but recently zirconium oxide, obtained as a by-product in the preparation of titanium oxide and ferro-titanium, has come to the fore as a material possessing much greater opacity and at the same time being suitable for this use. Some of the large pottery manufacturers have found that the new material effects considerable economies in operation while producing a ware of equal or superior quality. Zirconium oxide has also been used to some extent as a refractory for very high temperature work.

It is interesting to note that the larger production of titanium oxide for use as a pigment to replace white lead in the new nitrocellulose lacquers has contributed to the production of zirconium oxide in quantity and at a price to make it favorably competitive with tin. Thus at a single stroke is accomplished the conservation of two important common metals, lead and tin, and two others, ordinarily considered rare, are put usefully to work in industry.

Solid Fire Extinguisher

WORD comes from Germany of the use of solid carbon dioxide as a fire extinguisher. Undoubtedly it is excellent for this purpose but the great difficulty of keeping it and its comparatively high cost would scarcely lead one to think seriously of it as a practicable proposition. It is of course possible to extinguish fires readily with pure woolen blankets, but it is scarcely probable that fire departments will be likely ever to use immense quantities of them for this purpose.

Potash in Texas

FROM time to time during the past few years we have received requests for opinions concerning the large areas on which it is said potash has been discovered in Texas. Our replies have been conservative, as we believe should be the case before dependable information is available. Now that the United States Geological Survey has rendered a report on the Texas potash beds we are willing to go a step further: it appears that there are good grounds for optimism concerning the availability of these deposits.

"The great interest in the development of further sources of potash in the United States, shown by the Congressional appropriation which is to be expended in drilling by the Bureau of Mines, renders of great interest the little United States Geological Survey bulletin on Potash Investigations in 1924, by Walter B. Lang, published recently," says *The Engineering and Mining Journal* (New York), in the informative editorial we quote. "The area which is regarded as a potential source of potash lies in western Texas, 500 miles from Galveston, the nearest great shipping port.

"The existence of potash in this area was first definitely proved about twelve years ago by Dr. J. A. Udden, of the Texas Bureau of Economic Geology and Technology. The suspicion arose through comparative stratigraphy, for the Permian strata of western Texas are correlated with the Permian in the Stassfurt region of Germany, where great potash deposits are mined. A deep test hole in Dickens County, Texas, yielded brines from a depth of 2,200 feet which contained 5.4 percent of potassium and this started the further efforts at investigation of which the proposed work by the Bureau of Mines is the latest.

"During 1924 the Geological Survey pursued field investigations, and made studies of wells that had been drilled primarily for petroleum. The result was the establishing of appreciable quantities of potash in many wells, situated in a number of counties in Texas, so that the author feels that the data 'strengthened the conviction that the presence of commercial beds of potash in Texas and possibly in Utah will be proved when suitable means are utilized to demonstrate the facts definitely.' This is a most encouraging opinion, and a more definite one than the Geological Survey has hitherto allowed itself to make. The well records showed all the way up to 22.9 percent of potash. The drillings indicate the existence of a number of beds of polyhalite, the complex salt which is one of the chief sources of potash in the German deposits. Carnallite, another of the potash salts of Germany, has been found in Grant County, Utah, at a depth of 3,150 feet and deeper.

"Three attempts by the Geological Survey to drill for potash, in Texas and in New Mexico, in 1917, failed to yield results: but this, it is believed, was either because there were not sufficient funds to go deep enough, or because the sites chosen were unfortunate. Since then, however, the 'wildcatting' stimulated by the development of four oil fields within the salt area, has furnished abundant and definite data as to the widespread existence of potash salts in this field.

"As to mining conditions the bulletin states that 'There is little reason to believe that the geologic conditions in the potash area of western Texas offer difficult problems to the mining of the potash salts. So far as known at present, mining will be necessary to extract the potash, as the mineral polyhalite, which carries the potash, is relatively insoluble in comparison with the associated halite' (common salt). Mining methods are necessary in Germany, and in the Tertiary deposits in Alsace: in Germany it is necessary to mine at depths of 3,500 to 5,000 feet: in Alsace, on the average 1,700 to 2,200 feet; whereas in western Texas commercial ore is indicated at as shallow a depth as 900 feet, and the maximum appears to be 1,800 feet. The author finally states with regard to the beds of potash-bearing salts in Crane County, Texas: 'Their favorable composition, combined with their relatively shallow depth, places them in favorable comparison, from the miner's standpoint, with the deposits of Stassfurt and Alsace.'"

First Enzyme Isolated by Cornell Chemist

THE isolation and crystallization of the first enzyme has been achieved by Dr. James B. Sumner, assistant professor of biological chemistry at the Cornell Medical College. Success came only after a period of research covering nearly nine years. During a part of the time Dr. Sumner was assisted by Dr. Viola A. Graham and by Dr. Charles V. Noback.

The enzyme isolated is known as urease and occurs in the jack bean, in the soy bean and in a great many kinds of bacteria. It has been found in the horseshoe crab and in the lining of the stomach. Urease is important in the cycle of nitrogen because it converts the urea that is produced by animals into ammonium carbonate, which is used by the plant, usually after conversion to nitrates by bacteria.

Chemists have been attempting to purify enzymes for nearly a century, but up to the time of Dr. Sumner's discovery no enzyme had ever been prepared in pure condition, and the chemical nature of enzymes was entirely unknown. Indeed, a prominent worker in this field, Dr. Richard Willstatter of Germany, recently declared that the enzymes belong to no known group of chemical substances.

An enzyme, the word meaning "in yeast," is a substance elaborated by plants, animals, or micro-organisms that accelerates chemical reactions without itself being used up in the process. In other words, an enzyme is a catalyst. But the enzyme is a catalyst of a special sort. It is extremely unstable and of colloidal nature. These are the chief reasons why the isolation of an enzyme has been considered an almost impossible task. Enzymes are sometimes called ferments because they cause fermentations. Of the great number of enzymes found in living cells a few examples are: zymase, which is present in yeast and which is responsible for the alcoholic fermentation of saccharine liquids; rennin, which is obtained from the stomachs of calves and which is used in the manufacture of cheese; pepsin, which is present in the gastric juice and which digests meat; and thrombin, which is necessary for the coagulation of blood.

Urease has been prepared by Dr. Sumner as octahedral crystals that are slightly larger in diameter than human red blood corpuscles. The crystals are protein and belong to the class known as globulins. They are able to transform their own weight of urea into ammonium carbonate every 1.4 seconds at room temperature.

The isolation of urease has opened up new fields for research and is expected to aid in the solution of many problems of the chemistry of enzymes and to lead to the isolation of still other enzymes.—*Science Service.*

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Plylock—"Wood that's stronger than wood" is the ideal material for meter panels. Its laminated construction of durable Douglas fir veneers eliminates warping and curling. This in turn does away with stresses and strains which, transmitted to meter mechanism, tend to affect their accuracy.

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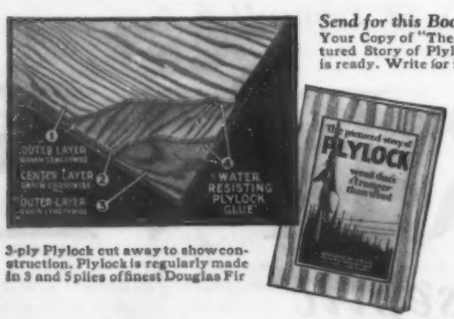

3-ply Plylock cut away to show construction. Plylock is regularly made in 3 and 5 plies of finest Douglas Fir

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Your Copy of "The Pictured Story of Plylock" is ready. Write for it.

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

Coast Guard Air Service

THE service applications of the airplane are innumerable. Fighting the rum runner will now be one of its functions, since the delivery of three Loening Amphibians to the United States Coast Guard Service. This airplane should be particularly useful to the Coast Guard because of its ability to patrol a vast expanse of sea at great speed while radio keeps it in touch with the water craft of the service. It is interesting also to learn that experiments have been carried out by Lieutenant Commander C. G. Von Paulsen with a special type of reel and life line which the airplane can carry out to wrecks that are too far from shore to be reached by the usual life-saving mechanisms.

The Amphibian is particularly adapted for this sort of work because it can be beached readily anywhere along the coast on its own wheels, and because it can travel inland whenever required. Our photograph shows the very latest type of the Loening craft. To guard against injury in rough water or on a rough beach, and to protect it against driftwood, the hull has been provided with a metal cover three times the usual thickness. The wing-tip floats are now protected by special skids for beaching purposes.

To render the craft thoroughly visible out at sea, the entire area of the wings and body have been painted a bright chrome yellow. The wheels can be fitted into the recess in the hull in a few seconds by a simple mechanism, now operated by hand. The three-bladed propeller is of steel, with blades whose pitch can be adjusted on the ground. The inverted Liberty engine, besides providing excellent visibility for the pilot, is standing up very well in practice and giving a slightly better performance than the ordinary Liberty.

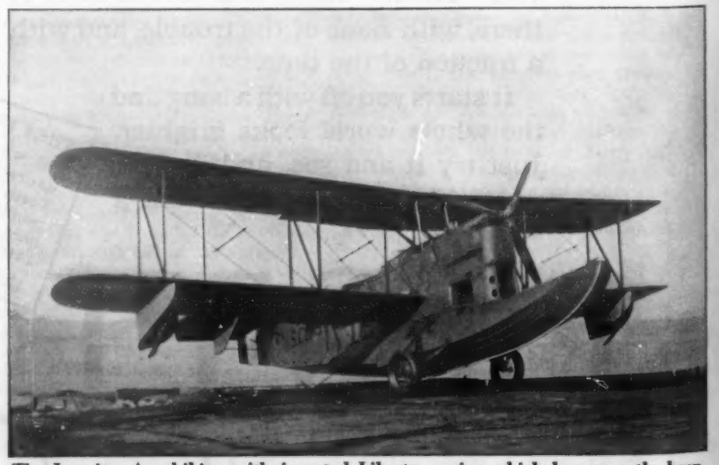
Is Weather Control Possible?

THE possibility of weather control and particularly of fog dissipation is a fascinating subject for the aviator. In an interesting little book entitled "Rain Making and Other Weather Vagaries" (Williams and Wilkins Company, Baltimore), Dr. W. J. Humphreys of the United States Weather Bureau discusses the problem in masterly fashion but holds out little hope for its solution.

Magic and prayer are not efficacious. Noise and the gun fire of the battlefield were considered rain producers for many years. In 1891 Congress went so far as to appropriate 9,000 dollars for experiments conducted by General Robert Dyrenforth in sending up dynamite in hydrogen-filled balloons. The result was noisy but the little rain which fell was due to fall in the regular and undisturbed course of the weather.

Thunder is not the cause of "rain gush." Rather, the coalescence of a large number of suspended raindrops produces simultaneously the fall of rain, the lightning discharge and the thunder. Unfortunately the flash travels 186,000 miles per second, the thunder travels with the velocity of sound, approximately 1,100 feet per second, and the dawdling rain falling at 25 feet per second reaches our senses last. Hence the misconception that the thunder brings the rain.

Blowing warm air upwards would indeed cause precipitation and rain, but the engineering effort involved is beyond all human possibilities. Building a ridge 100 miles



The Loening Amphibian with inverted Liberty engine which has recently been delivered to the United States Coast Guard for fighting the rum runner. The wheels can be hidden in the recess in the hull by a simple hand-operated mechanism which functions in a few seconds

long and one mile high to catch rain is a suggestion equally sound in principle, but equally fantastic in practice.

In attacking fog that may cover an airdrome dangerously, we are faced with a similar plausibility of principle and tremendous difficulty of execution. Dr. Humphreys discusses authoritatively three proposed methods. One might fly back and forth over the airdrome and sprinkle the fog with electrified sand. Each grain of heavily charged sand would certainly clear up a certain volume of fog by attracting particles of mist in its fall. But to clear up an airdrome 1,640 feet square, over which fog is drifting at say 300 feet a minute, 2,000 to 2,500 pounds of electrified sand per minute would be required!

The most obvious method of clearing away fog is to evaporate it by a suitable application of heat. But for the same size airdrome we would have to burn 35 tons of coal an hour, and how to burn this vast quantity of fuel so as to heat only the fog-laden air is an engineering problem as difficult as the problem of cost.

The third plausible method is to drain the fog through an underground tunnel. Here calculations of the most optimistic character lead to the hopeless answer that 110,000 horsepower would be needed for the ventilating machinery. Perhaps a stroke of genius will bring these pessimistic prognostications to nothing. However, the outlook is not promising.

A Crash- and Bullet-Proof Tank

THE London *Aeroplane* describes tests of a new crash- and bullet-proof fuel tank invented by Major H. H. Evans. The material used is of a gelatinous nature, which can be melted and cast around any type of gasoline tank, the only preliminary treatment being the application of a coating of an adhesive varnish.

The protective coating is ½-inch thick and weighs about ½-pound per square foot of protecting surface. It therefore adds appreciably to the weight of the tank, which is always a disadvantage in airplane practice. But numerous revolver-bullet holes, holes made by a hammer-driven screw driver, and throwing the tank down violently on a stone floor, failed to make it leak, and the device successfully withstood the external application of flame after the puncturing and hurling process.

Rubber coated tanks are equally leak and crash proof, but rubber deteriorates rapidly and is itself inflammable.

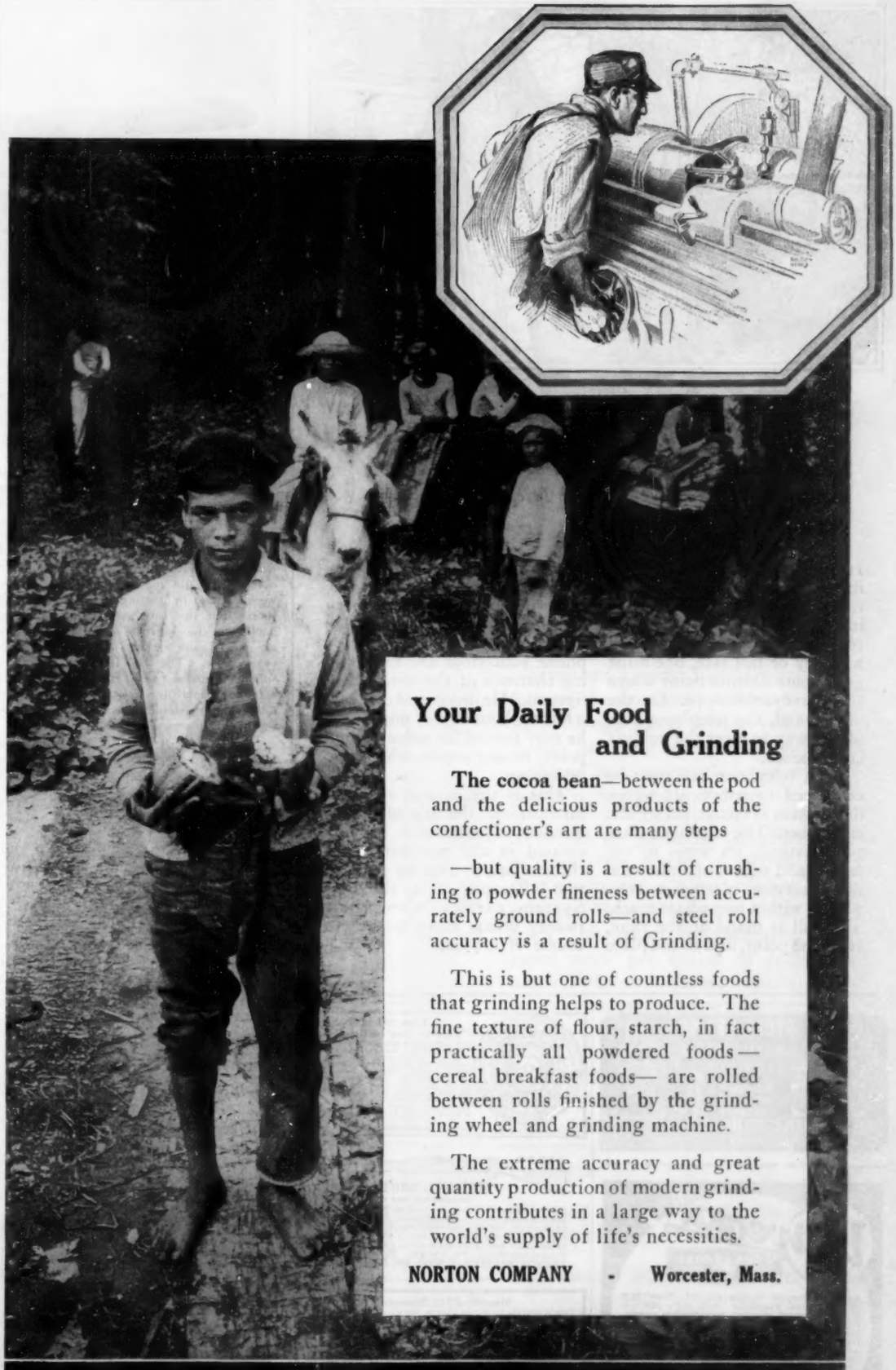
In the case of a crash, the greatest danger of fire arises from the spreading of the gasoline over a place where a fire already has started in some fashion. There then follows an explosion which is too rapid to permit of escape or rescue. So far, crash-proof tanks have been used for military airplanes only. Perhaps commercial planes may some day be thus equipped, in spite of the additional weight.

The Airman's Eyes

AFTER several years of flying an aviator may find that his eyes need care. The malady is termed "snow blindness," although it is caused not by snow but by the effect of the sun's rays on minute particles of dust and moisture in the air, each acting like a tiny mirror.

Moreover, the axis of vision of the normal eye is so constructed that it is normally parallel to the earth's surface, and the light received into the eye is that reflected by objects on the surface. The eye is perfectly adapted to its usual environment and is desensitized over its lower portion. At great heights, unnatural light of equal intensity enters the eye from all angles, and tends to deaden its upper unprotected portion.

New goggles now tested at the New York Navy Yard remove these dangers. They are much larger than those used in the past. A system of ventilation is provided so that the eye is kept cool in its cup, while still shielded from the wind. The lens of the goggle follows the contour of the face, and



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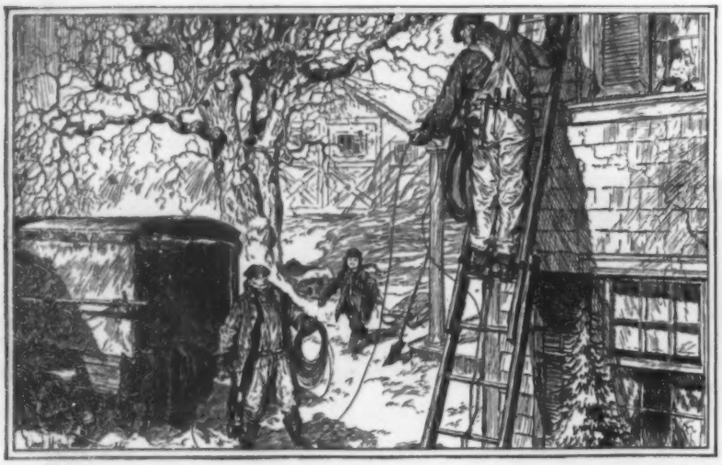

Service All the Way

An Advertisement of
the American Telephone and Telegraph Company

It is impossible for a railroad train or a ship to call at the doorsteps of its passengers when they wish to take a journey. To take even a trolley or bus ride, one must go to some definite point where the conveyance stops. On the other hand, the telephone goes all the way to meet the public's convenience.

Each telephone call may be compared to a taxicab, whose destination is controlled by the subscriber. The telephone company extends its wires to the homes and offices of those who desire service, placing its telephones within immediate reach. The call is made at the time, from the point, and to the place that the subscriber desires. He speaks to the person he wants—wherever he may be.

At the disposal of each telephone subscriber are the talking channels of the entire Bell System. He may make a call a few or thousands of miles, and he may extend his voice to any point, to any person who has a telephone.

This is the essence of communication. Because of it, the number of telephones has increased in the last five years three times as fast as population. Because of it, the Bell System carries more than twenty billion messages in the course of a year.

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is a combination Mannheim, Polymetric, Log Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with Engine-Divided scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Pocket Case 50c extra. Cash or C. O. D. Catalogue Free.
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MARINE 10-15 MOTOR H.P.
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ULTRALENS MICROSCOPE
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SCIENTIFIC APPARATUS CORP. Dept. 109 Milton, Pa.

P & A Photos

Front view of the *Hercules*, showing the wide landing-gear tread

is sage green in color, having two-thirds of the transmission of clear glass. The lens allows the pilot to distinguish color but prevents the transmission of the injurious infra-red and ultra-violet rays of the sun.

A British Passenger Plane

THE British Imperial Airways is inaugurating a passenger service between Cairo, Egypt, and Karachi, India. In their European service, the Imperial Airways reports one forced landing in 15 flights, half the forced landings being due to bad weather. Unfavorable weather is less likely over the Asiatic route, which is to save a week's time in getting from London to India; but the consequences of a forced landing in the desert or other wild territory are much more serious than on the European route. The De Haviland Company which is furnishing the three-engined *Hercules* for this airline has therefore sought to attain the maximum reliability by providing a multiple power-plant.

The *Hercules* is to carry a pilot and a mechanic, 14 passengers, and 300 gallons of gasoline, giving a range of approximately 400 miles. The three Jupiter engines develop 450 horsepower each. The weight of the plane fully loaded is 14,700 pounds, giving a loading of only 10.9 pounds per horsepower. The area of the wings is 1,536 square feet, so that the wing loading is also moderate. These low loadings in themselves tend to give reliability; with only the central engine functioning, the plane lost but 500 feet of altitude in a ten-mile flight. The top speed is 125 miles per hour, and the cruising speed is 100 miles per hour. The span of the wings is 79 feet 6 inches; the over-all length 55 feet 6 inches; the height 19 feet 3 inches.

Recent medical investigations presented at the Brussels International Air Congress show that the air sickness of passengers is largely due to stale air. Particularly under tropical conditions does ventilation become of prime importance. A number of ventilating systems will be tried out on the *Hercules* in turn. The one first fitted to the machine includes a large air-scoop mounted above the fuselage at the front of the cabin.

Air from this scoop is passed into a diffuser box of large capacity and then discharged into the cabin through a large area of porous fabric which should effectively prevent the formation of any draughts. The windows at the side of the cabin provide additional ventilation and excellent vision. The center exhaust pipe can be made to heat an "air muff" so as to supply warm air to the cabin whenever needed.

Noise is another great enemy of passenger comfort. Sometimes after a trip of two or three hours, passengers are slightly deafened for a period as long as that of the journey itself. In the *Hercules*, a timber-framed and plywood-walled cabin is contained within the steel-tubing fuselage as a separate unit. Thus, except at the window spaces, the whole of the passenger compartment is insulated from noise and heat.

The power-plant installation has been carefully studied. The head resistance of an air-cooled engine is very large. We are accustomed, in small fast planes, to see the engine cowled in as much as possible, but in the comparatively slow *Hercules*, to be used in hot countries, the engine is left

P & A Photos

Side view of the De Haviland *Hercules*. This large three-engined craft is to be used on the new British airline between Cairo, Egypt, and Karachi, India. The designers have sought ruggedness and reliability, but have somewhat disregarded appearances, plastering the airplane with ugly projections

Underwood and Underwood

A Ford passenger plane, carrying eight passengers in a comfortable cabin at a cruising speed of 100 miles per hour. The total horsepower of the three Wright Whirlwind engines is 600 horsepower

entirely exposed. Leading the exhaust away from the nine cylinders is quite a problem. It is evidently impracticable to have nine long exhaust pipes for each engine. Accordingly, the exhaust from each cylinder is led into a circular collector ring. The collector ring is kept from getting too hot by the propeller slip-stream. It discharges into two long pipes which lead behind the trailing edge of the lower wing, eliminating exhaust odors and fire danger. The exhaust pipes are closed at their ends, but are pierced at the sides with a large number of small holes. This serves as a somewhat crude form of muffler.

There are two fuel tanks, mounted at the center of the upper wing, which serve to feed all three engines. The fuel feed is therefore by gravity which is the simplest and most reliable system. Apart from the common fuel system, each engine is arranged as a separate power unit, with its own oil tank and instruments. In automobile engines, there is a large sump which serves effectually to cool the oil. In airplane practice, particularly where the crankcase is as small as in the radial air-cooled engines, a special oil-cooler has to be employed. This consists of a small tank through which the oil passes from the engine, and which is pierced with a number of tubes through which the air rushes, carrying away excess heat. The disadvantage of such a cooler is head resistance. Perhaps the main oil tank itself could be used as a cooler by making its walls part of the smooth outer surface of body or nacelles.

A moment's thought will show that the engine controls of a three-engined ship must of necessity be complex. So is the instrument system. A somewhat ugly projection on the interplane struts above the engine carries the revolution indicator, the oil pressure and oil temperature gages. True, these instruments are mounted at the pilot's eye-level, but the sighting arrangements are not ideal. The development of reliable engine instruments which will indicate at a distance is still a problem for designers and inventors.

In their search for reliability the British show a strong disregard for appearances. Thus, the tail-surface control-wires are seen emerging in all crudity from ahead of the pilot's cockpit. There is, however, one advantage to this which is that they are at all times visible to inspection. The gas starter, which can be made to start each of the engines in turn, is mounted on top of the fuselage just behind the pilot. It certainly looks very untidy. The practical British advance several reasons for this exposed position. It can be used by the pilot without leaving his seat; is not likely to be damaged in case of a bad landing and can be used in emergencies to drive the wireless generator, which is normally wind driven.

It might be thought that several wheels would be needed to support such a large craft. Apparently two wheels are ample. The *Hercules* has a wheel base of 23 feet, a safeguard against sidewise tipping. The landing carriage is simplicity itself. It consists of two bent axles which hinge at the fuselage, and two V struts at either wheel, the front of which is telescopic and carries rubber discs in compression to take up shock. The outer engines are thus most effectively supported on landing. However, we are inclined to think that in a heavy landing, the weight of the fuselage is likely to bear down strongly on the wings, and that herein lies a structural weakness.

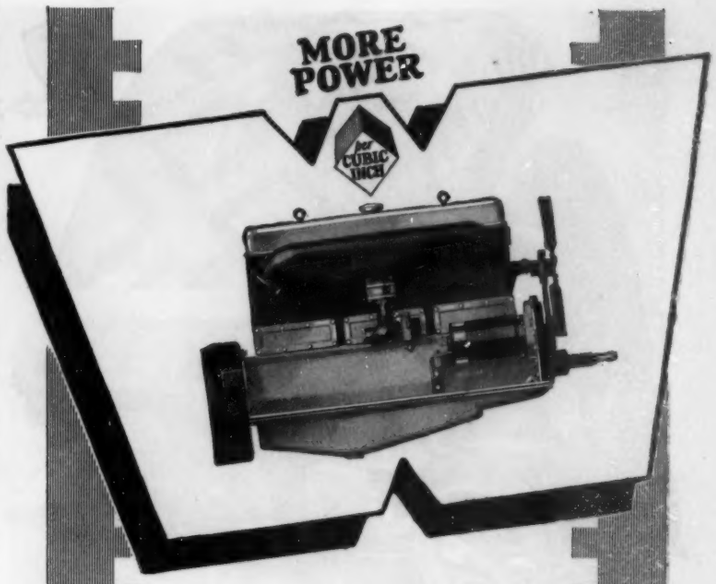
The operation of *Hercules* under the trying conditions of this Asiatic line will certainly be watched with interest.

An American Passenger Plane

THE Ford Motor Company is now putting on the market a three-engined passenger plane which is in sharp contrast to the British *Hercules*. One of these planes has already been sold to the National Air Transport Company operating between Chicago and Dallas, and it is planned to put the ship into production on a basis of two a week. This is an unheard of rate for large planes in commercial aviation and is perhaps an augury of the semi-mass production which we may expect in a year or two. It is not probable however that airplanes will ever become as standardized as automobiles; the variety of forms and sizes and purposes is too great.

Conservative British designers still stick largely to the conventional biplane structure. The American-built Ford plane is of the thick, cantilever wing type, and is entirely of metal instead of wood and fabric. The three Wright Whirlwind engines of 200 horsepower each show some attempt at "cowling in" and the spinners at the front of the propellers increase the streamline appearance. The American designers do not give themselves so large a wheel tread as the British and they also bring the engines in together as closely as possible, in order to diminish the unbalanced turning moment when an outboard engine fails. This has disadvantages in interference between the slip-stream of the front propeller and the blades of the two rear propellers when passing their centermost position.

The landing gear is certainly of a better structural design than the British one. There is no bent axle, and two struts on either side support the great weight of the fuselage with its forward engine and passengers. It is significant to learn that the



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MOST MILES PER DOLLAR

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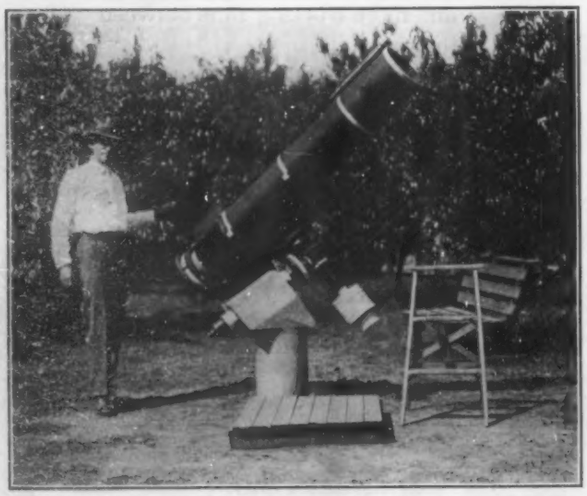
AMERICANS SHOULD PRODUCE THEIR OWN RUBBER Harvey S. Firestone

HE BUILT IT HIMSELF!

SO CAN YOU



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SCIENTIFIC AMERICAN - 24 West 40th Street, New York

Ford Motor Company will now abandon its single-engined plane and concentrate exclusively on the type described in this note.

Releasing a Dual Control

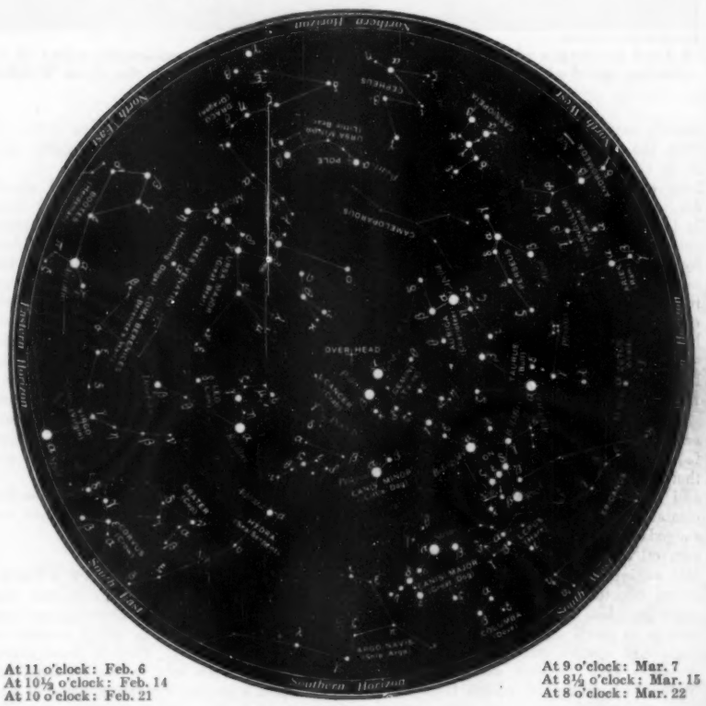
AIRPLANES are often designed with dual control and they are sometimes used for student instruction, sometimes for the carrying of passengers. Earle Ovington, writing in *Aero Digest*, describes an accident in which he broke a record of 15 years of perfectly safe flying. Two passengers were in the front cockpit, man and woman. When close to the ground, Ovington gave the ship a little rudder to make a gentle turn and subsequently found that his rudder had jammed by interference with the passengers' feet. He got out of a tail spin by brutally forcing the rudder but landed in a horizontal crash.

Similar accidents are not unknown in instruction where a student sometimes "freezes on" to the "joy stick" and has to be stunned to release it. For maximum safety, we suggest that in all dual-control ships, the control system in the passenger cabin be such that it can be instantly disconnected by the pilot.

Such release mechanisms were designed during the war but have fallen into disuse, owing presumably to the slight extra cost and complication. Certainly it should be possible to disconnect the rudder without much difficulty. The wires from the passenger's rudder-bar could, for example, come to an auxiliary rudder-bar situated directly under the pilot's rudder-bar. A square hole would be provided in each of them. With a square pin in place the two bars would act as a unit; removal of the pin would effect complete release of the steering system in the passenger cockpit.

The Heavens in February

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Feb. 6
At 10½ o'clock: Feb. 14
At 10 o'clock: Feb. 21

At 9 o'clock: Mar. 7
At 8½ o'clock: Mar. 15
At 8 o'clock: Mar. 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

The Heavens

AT the hour set for our usual view of the stars (and indicated below the map) we find Leo high in the south. Below is the long irregular line of Hydra with the smaller groups of Crater and Corvus on the serpent's back.

Virgo is in the southeast, and Boötes in the east, with Corona and Hercules below. The Great Bear is very high in the north, the Little Bear and the Dragon below, and Cepheus and Cassiopeia close to the horizon.

The finest part of the sky is in the west, where the winter constellations are bidding us farewell—Perseus and Auriga in the northwest, then to the left Taurus and Gemini, then Orion and Canis Minor, and last of all Canis Major in the southwest.

The Planets

Mercury is in conjunction with the sun on the 15th, on the nearer side, and is practically invisible, except perhaps as an evening star at the very beginning of the month, or as a morning star at its end, and in either case with difficulty. Venus is an evening star, slowly and steadily climbing out into a more and more conspicuous position. In the middle of the month she sets a little after 8 P.M. and is very prominent.

Mars is an evening star, past quadrature, and has lost most of his glory. He now appears as a reddish star, somewhat fainter than Aldebaran, which is apparently his neighbor as he moves eastward through Taurus.

Jupiter is in conjunction with the sun on the first, and is visible only at the close of the month, as a morning star low in the dawn. Saturn is just past his western quadrature, and is visible in the morning sky, rising near midnight in the middle of the month. Uranus is in conjunction with the sun on the 21st and is invisible. Neptune is in Leo, just past opposition, and observable for most of the night.

The moon is new at 2 P.M. on the 3rd; in her first quarter at 6 A.M. on the 10th; full at 5 A.M. on the 18th, and in her last quarter at 7 A.M. on the 26th. She is nearest the earth on the 4th (when the tides will run high!) and farthest off on the 18th. During the month she is in conjunction with Jupiter on the 3rd; Mercury and Uranus on the 4th; Venus on the 5th; Mars on the 9th; Neptune on the 15th; Saturn on the 24th, and with Mercury and Jupiter again on March 3.

At 10 A.M. on the 21st the sun crosses the celestial equator and enters the sign of Aries, and "spring commences."

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Amateurs Total 14,902

GOVERNMENT figures made public recently show that there are now 14,902 radio amateurs in the United States. This is slightly below the number given for last year, which was 15,111, but because of the two-year period of licenses, with renewals yet to come, it is believed that there are actually more now than then.

The names of the amateurs are set forth by city and state in the list of "Amateur Radio Stations of the United States," which may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 25 cents a copy.

New York City has 717 amateurs; Chicago, 419; Philadelphia, 335; Los Angeles, 383; San Francisco, 234; Oakland, California, 274.

Lodge's "N" Circuit

SIR OLIVER LODGE has invented a new radio hook-up which he calls the "N" circuit.

"In designing the receiver which has now become known as the 'N' circuit," said Sir Oliver Lodge, "my object was first to provide a wireless set that would not oscillate or cause interference with neighboring sets (and this is very necessary if we are all to enjoy the broadcasting, just as traffic control on the roads is necessary if we are to have safety); secondly, to provide a set which would be perfectly simple to operate and yet would receive programs from the local stations as well as the distant stations. If the 'N' circuit were universally adopted there would be an end to the oscillation nuisance."

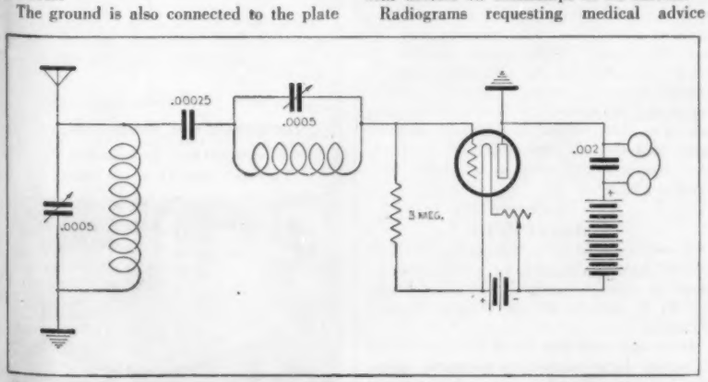
From this short statement it will be seen that the scientist's object has been to eliminate the "blooper." Because of their excellent amplification, regenerative circuits have always been popular, but their use has been coupled with the "howling" nuisance.

The fundamental principal of the "N" circuit is the use of a single connection between the antenna and the detector tube which forms a closed oscillating circuit. The antenna circuit itself need not be a tuned circuit, but can be of the aperiodic type. The "N" circuit has a very low resistance, so that comparatively high voltages can be generated by small voltage impulses.

Sir Oliver Lodge contends that for good quality of reproduction there should not be more than one tuned circuit, as, if two tuned circuits be employed there is a great liability to distortion owing to heterodyning between the circuits.

In the "N" circuit, the coil is made of a fairly high inductance value and the capacity of the condenser is kept small. Owing to the much greater length of the antenna system, and to its damping, it is impossible for radiation from the antenna to occur.

The ground is also connected to the plate of the detector tube, and there is a high resistance between the grid and the filament circuit.



The fundamental connections of a set using the hook-up called the "N" circuit by its designer, Sir Oliver Lodge, well known British scientist

Warning Signal Needed

HEREAFTER broadcast engineers are likely to string extra emergency wires to the microphone into which the President of the United States talks so that the Chief Executive will not be embarrassed by speaking into a "dead" microphone, as was the case when President Coolidge spoke at a recent meeting in Washington.

President Coolidge took his position in front of the microphone and, as far as anyone knew, everything was going nicely and the radio was functioning. Suddenly, to the consternation of the broadcasting crew, it was discovered that the telegraph wire which had been tested a half an hour previously had "died."

F. P. Guthrie, district manager of the Radio Corporation in Washington, said that the telegraph company had reported to him that the wire had been short-circuited by the accidental moving of a piece of scenery on the stage. It is certain hereafter when a speech of the President of the United States is relayed over wire lines that they will be more closely supervised and that a second or third wire may be strung along in case anything should happen to the others, according to reports from Washington.

Another thing which the President's experience has suggested is that some sort of device be attached to the microphone—perhaps a tiny colored light—to advise the speaker that the carrier wave is off and that the speech is not being broadcast.

Medical Service

THE free medical radio service inaugurated by the United Fruit Company some time ago from its hospitals in the various countries of Central America and from the passenger ships in its service is now available to all ships at sea, through an additional number of stations. These include WBF, Boston; WAX, Miami; WNU, New Orleans; WBW, Burrwood, Louisiana; WIO and WNN, at Fort Morgan and Mobile, Alabama, respectively, and about nine stations in Central America. All passenger ships of the United Fruit Company carry doctors, and free medical service may henceforth be secured by radio from any of them by addressing a radiogram to the ship's doctor, followed by the name of the steamship.

It is explained that this free medical service is maintained by ships at sea which do not carry physicians. Should occasion require, however, the doctors of other ships may hold consultation by radio with the United Fruit Company's hospital staffs or with doctors on steamships in its service.

Radiograms requesting medical advice

This is the Heavy-Duty battery in which the new Layerbilt construction provides greater economy

THERE's an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duties cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layerbilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical — we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Layerbilt's remarkable life is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections bridging the gaps.

Several years ago we struck boldly out, away from this tradition, seeking a better method. We wanted to avoid waste space, minimize soldering, and get more current and longer life from a given quantity of active materials. The Eveready Layerbilt is the result.

This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Layerbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

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WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
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Ask Any Radio Engineer

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Fifth and King Ave. Columbus, Ohio

Wide World

Major Francis E. Pierce of the United States Marines built this transmitter which weighs five and one-half pounds and has a radius of 300 miles

should be signed by the captain of the ship and should state briefly but clearly the symptoms of the person afflicted. Such radiograms will be given preference over all others, excepting SOS calls, throughout the service of the Tropical Radio Company and the United Fruit Company.

Applause Fades

FOR every five hundred listeners, the majority of broadcasting stations receive an average of one letter in response to a program, according to a report made by Charles W. Burton, Broadcasting Superintendent of WEEI, Boston, Massachusetts, to the Boston Chamber of Commerce.

"When we consider the multiplicity of good entertainment crowded into the air, with one feature program following on the heels of another from a number of stations, each of which is available at a twist of the wrist, we wonder that anyone is sufficiently impressed by any one program to write a letter to the station about it, and we also wonder that every program gets its share of mail," said Mr. Burton.

"Why should stations expect applause letters, anyway? How many persons write to a talking machine company after hearing a record they like? Does anybody write to the publisher of a book he has enjoyed? Of course not; not often, anyway. Then why should stations adopt the attitude that it is the duty of the public to acknowledge in writing every broadcast program that meets with favor?"

Baffle Board Tends to Improve Cone

THE tone quality of the average cone-type speaker may be considerably improved by simply mounting it behind a hole in a board, according to C. W. Peterson, acoustic engineer. The board, or "baffle," serves to accentuate the low tones which usually are lost in radio reproduction.

For a baffle he uses a square board measuring about four feet on each edge or a round board of equal diameter. A hole is cut in the center of this board the size of the speaker cone. The speaker is then mounted on the back of the baffle, so that the point of its cone extends through the hole, and the whole unit is hung near a wall.

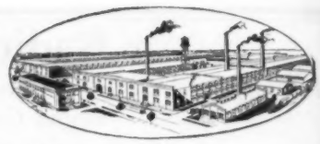
Mr. Peterson explains that the result of this arrangement is that low musical notes are brought out with surprising clarity. The tone quality is more mellow, full and pleasing than can be obtained with any ordinary loudspeaker. Music sounds more natural, and static and other high-pitched noises are reduced.

"The radio fan who wants to try this scheme with his cone-type speaker can do so with very little trouble," said Mr. Peterson. "It is merely necessary for him to get a board of the proper size, cut a hole in it the size of the speaker, and mount the speaker on this board so that it lines up with the hole. It is usually possible to remove the base of the speaker so that it can be mounted easily. The front of the board may be covered with tapestry or decorated so that it presents a pleasing appearance, and then the assembly may be hung in a corner of the room or any other convenient place."

Battery Hints

A REPORT relative to estimating the life of "B" batteries containing helpful suggestions to radio set owners, has been issued by W. B. Schulte of the Burgess Battery Company.

It is suggested that when the total hours of service have reached the computed value, the broadcast listener remove his detector battery and replace it by one which has



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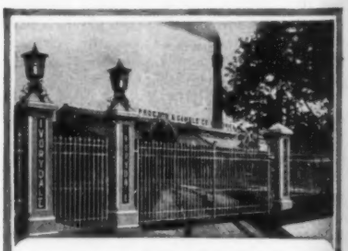

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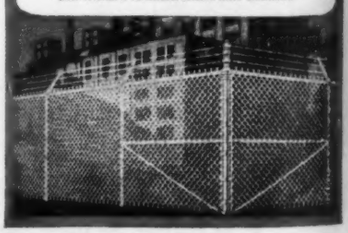


been on the amplifier circuit. If later the signals begin to fade, this battery can be removed to the amplifier unit and replaced by another which has not been on the detector. The battery service then is distributed between all of the batteries and it is estimated that from 10 to 20 percent more service-hours can be obtained.

It is pointed out that much of the service life of dry-cell "B" batteries in receiving sets depends upon the conditions of use, together with the type and number of tubes. The service-hours are the total time that a battery will deliver the necessary current before it must be discarded from the set as being no longer useful. High service-hours are therefore requisite for economical operation.

"Inasmuch as the average 'B' battery is put into use within a few months after manufacture, the broadcast listener need not fear a serious loss caused by shelf depreciation," said Mr. Schulte.

"A good shelf-life characteristic is obtained by perfect insulation between cells, which allows no internal cross currents and a resulting decrease in service-hour capacity. Excessive heat during storage lowers shelf life by drying out the chemicals in the battery. Impurities in the chemicals will likewise cause the cells to lose their capacity through internal action.

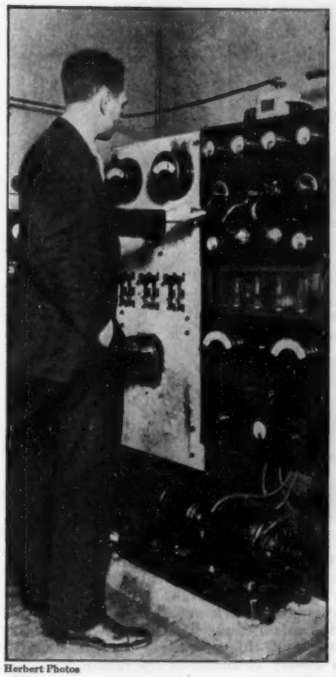
"The current from a 'B' battery to a tube does not remain constant but drops off as the battery voltage decreases. Therefore, to estimate the service-hours of batteries on various tubes it is necessary to know the average working voltage of the batteries as it drops from the initial value to the end point of 17 volts. The average working-voltage may be considered as the average between 22 volts and the end voltage of 17 volts—that is, the average working-voltage of one battery dropping to 17 volts is 19.5 volts."

The 45-volt unit reaches the end of its usefulness when the voltage reaches 37 volts. "B" batteries should always be tested with a volt-meter after they have been in operation for an hour or two, otherwise they will show a deceptive reading because they recuperate while idle.

Darkness and Light Affect Broadcasting

RADIO waves are confined to traveling along the surface of the earth in the daytime. They cannot penetrate high into the air because of the ionization by the sun's rays. Ionization is a condition produced by the sun in which the air is partly broken up into electrically charged particles which retard the passage of radio waves.

At night the air is not ionized and the waves are able to shoot up to the upper conducting surface, known as the Heaviside surface, and travel along it over great distances because there are no objects to absorb energy from the waves as is the case along the earth's surface.



Herbert Photos

The control panel at station WWRL. The wavelength-changing dials and the rest of the apparatus are easily accessible. Note the motor generator

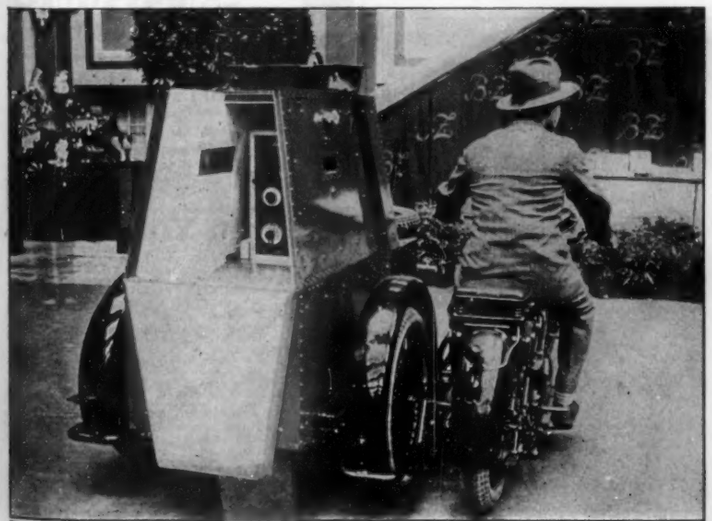
Denmark on the Air

A MORE powerful transmitting station than any now operating in that country is to be erected in Denmark, at Kallundborg. Its power is to be five kilowatts and it will work on a wavelength of from 1,000 to 1,250 meters.

At present there are five stations in use in Denmark, one of which, Soro, also working on a high wavelength, has been picked up throughout the world.

Protecting Rugs from Battery Acid

ONE of a series of home-economics programs broadcast by KOA, Denver, dealt with the topic, "What to do if radio-battery acid spills on fabric floor coverings or clothing." The speaker, Paul H. Bonham, warned that liquid in a storage battery is diluted sulphuric acid and will eat a hole in fabrics if not washed out immediately.



Herbert Photos

A new German invention incorporates a radio receiver and transmitter in the armored sidecar of a motorcycle. The armor not only protects the equipment from physical damage but also acts as a shield when the machine is in the vicinity of electrical devices which create interference

Safety—

First, last and all the time. Safety for the man in the air, for those below—and for the load being lifted.

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And that's why, so often, he specifies Yellow Strand Wire Ropes. He knows that the words, "Yellow Strand" designate a certain very definite high grade—and that the strand of Yellow that is "laid" into the rope prevents his accepting, by mistake, a rope of lower quality.

Pioneers in wire rope manufacture, the makers of Yellow Strand, also make all standard grades for all purposes.

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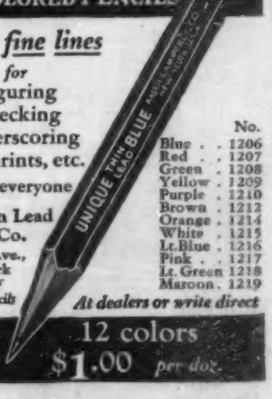

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What it costs to bend pipe out way, per bend:

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Turn Dial-get programs everywhere: 30 Days FREE!

MIRACO Unitune 5

28 in. high

Users report Miraco Radios get Coast to Coast, Canada to Mexico, loud and clear on speaker; outperform $100 to $200 sets. Some beat Europe. Marvelous bargain! Don't buy unless 30 Days Trial proves it. Most Selective, Clearest and Most Powerful Distance-Getter among big, fine 5-tube radios. Solid walnut cabinet. Write for Factory Prices—SAVE Up to ½. Every set completely assembled, rigidly tested, fully guaranteed. Ultra-5, $49.75 list. Speakers, batteries, tubes, etc. at big savings. Free literature, users' testimony and BIG SPECIAL OFFER.

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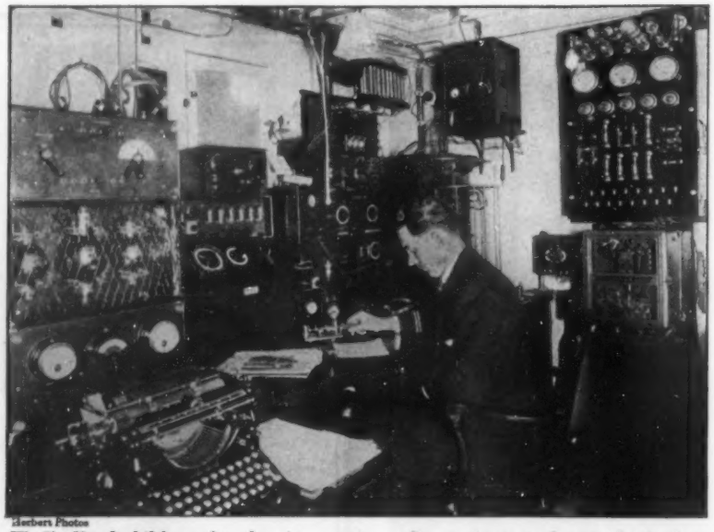
USER-AGENTS WANTED Write for discounts



Herbert Photos

W. K. Vanderbilt's yacht, the *Ara*, carries radio equipment almost identical to that of the *S.S. Majestic*. On the left is the one and one-half kilowatt transmitter, next the radio compass and then the receiving apparatus that covers both the short and the long wavelengths. To the lower right of the receiving apparatus is a one and one-half kilowatt quenched-spark set and over this is a one-half kilowatt emergency quenched-spark transmitter. To the right of these is the battery-charging panel. The call letters of this complete marine installation are FKBO. The various sets assure continuous operation

The broadcaster's first advice was, "Do not carry a storage battery across rugs or carpets, nor should the battery be permitted to touch curtains or draperies."

The following instructions were radiated for the benefit of radio fans who spill the storage-battery electrolyte: "Mix household ammonia with cold water in equal parts. Place a white blotter under the spot where the liquid soiled the garment, if it is clothing. Then use a medicine dropper to saturate the portion of the cloth covered by the battery acid. The blotter beneath the spot will attract the ammonia water through the fabric, washing out the acid. Tamp the spot with cheesecloth to absorb liquid from the cloth. Continue this until the threads have been washed thoroughly clean of acid. Then blot it as dry as possible and hold it before an electric fan until completely dry.

"Battery acid is treacherous in its damage to fabrics. A heavy acid stain may go unnoticed until the garment is washed or dry cleaned and ready for pressing. When the heat of the iron or moisture from steam used in pressing penetrates the cloth, a corrosive action causes immediate destruction of the fabric. If this happens, it is too late to save the cloth.

"Where the color of the rug, carpet or garment is black or blue the stains from the acid will change the colors to red. Dry cleaning may restore 'changed colors' by an alkali treatment if dry cleaned immediately, and if the cleaner is told that battery acid was spilled on it."

100,000 Listeners in Australia

THE number of receiving sets in Australia has increased 100 percent during the past year. Listeners there must have a government license, and already their number has considerably exceeded 100,000.

The radio programs are now considered so essential that an auxiliary plant driven by internal-combustion engines is now being installed at 2FC, one of the principal stations, so that there may be no delay in case of a breakdown. A new 5,000-watt station, 2BL, has been inaugurated at Sydney.

Canadian Stations

CANADA has 67 broadcasting stations. The Province of Ontario leads with 29. Quebec has seven; Saskatchewan and Alberta both eight. Nine are located in British Columbia. The law allows only one station to operate at a time in a city. This curtails the number of stations and minimizes interference.

Herbert Photos

Wei Yoh Wu, graduate electrical engineer and student at several American universities, built this regenerative receiver. The panel is of glass, backed with decorated silk to which real butterflys are attached. The set has one tuning control and utilizes resistance-coupled amplification

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With the third presentation of this department going to press, we find that the response from our readers has been gratifying. There is, however, one point which we wish to stress and that is that material submitted for consideration *must be new.* We will not knowingly publish material that has been published elsewhere, except in rare instances where credit is given to the original source. When submitting material, be sure to write your description on a separate sheet from your letter and that your full name and address appears on both. If possible, send photographs to illustrate your theme, but if this is impractical, rough sketches of the important or obscure points will suffice. Be sure to enclose postage if you desire the return of your manuscript, in case of rejection. ***The Editor***

Use for Coal Dust

COAL dust, the fine powder that covers the floor of coal bins, sometimes to a depth of an inch or more, has always been regarded as a total loss. It is almost impossible to make use of it in an ordinary domestic coal burner. However, we now have a report from England of a method whereby this substance may be used.

The process, which can be employed by anyone, merely consists of making a mixture of the coal dust with moist clay, rolling the product into balls and allowing them to dry. The two photographs in these columns show the method. A layer of moist clay is rolled out on a smooth surface and covered with a layer of coal dust reclaimed from the bin or made by pulverizing a poor grade of coal that would otherwise be unfit for use. The layer of clay is then folded over and over, thoroughly kneading it so that the clay and the coal dust enter into an intimate mixture.

The next step is to divide the mixture into small portions and roll each of these into balls as shown. These balls are then allowed to dry. They can now be used in place of coal in a stove or furnace and it is said that they will burn for several hours, giving off a great heat.

Door Bells

WHEN electric bells are used on two doors of a house, there is often confusion in determining just which button was pushed. Of course an annunciator will solve the trouble, but they are expensive and will require rewiring of the circuits. A far simpler way is to change the tone of one of the bells by cutting a slot in the edge of the gong proper. Another method that may be used, if not much volume is required from one or the other of the bells, is to remove the gong entirely, thus, in effect, making a buzzer of that particular bell.

Glass Repairing

WHILE the glass repairing method described on page 465 of the December issue will be found very good for fixing plate glass, still there is a simpler and less

International Newsreel

Coal dust or pulverized coal, mixed with clay, will form "briquettes" that will give excellent service for ordinary domestic use

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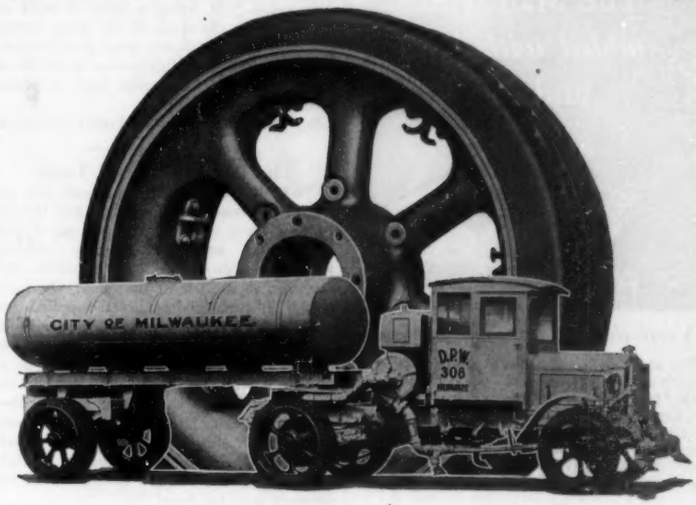

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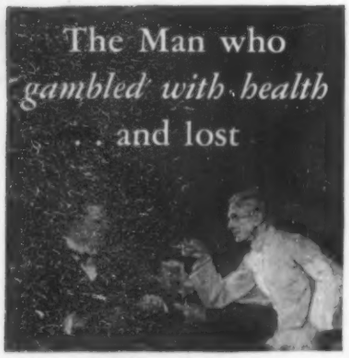

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unsightly way that may be made use of in the home when a thin pane is cracked. This consists of fixing a strip of mica or celluloid over the crack in the glass, fastening it in place with any good glass cement. The writer has used this system in his home and the repairs thus made have withstood washing for several years.

Contributed by DR. F. W. HARTLEY-HELLYER.

The Correct Use of Tools

TWO of the ordinary home tools that are often misused are the chisel and the bit. Both of these seem to be the acme of simplicity but nevertheless, many amateur woodworkers do not use them correctly. For instance, in the use of the chisel, the force of the blow must be so directly applied that it goes straight down the length of the chisel, but even that is not the whole art of the use of this tool, for the edge may be at an angle with the work, even though the blow is straight. "Edging in" with a chisel in mortise work is the most prolific cause of poorly made joints on amateur workbenches. The edge of a chisel is at right angles with its sides and should always cut squarely into the wood.

In making a mortise, the sides are usually

Chisel held straight—right

at right angles with the surface of the work, and the tenon which is to fit into the work is, of course, also an affair of right angles. To hold the chisel so that the edge of the blade is at any other angle than a right angle is to risk marring the edges of the mortise, and perhaps, if the mortise is "blind" and does not go through the wood, to cut too deeply in one part and leave an uneven "floor" or bottom to the "blind" hole. Of course, the chisel haft may be at an angle with the work when "lifting" out splinters and chips or making a "with-grain" cut, but the edge of the chisel should always be square with the work, regardless of the angle of the haft.

The right way to start a brace and bit job is the wrong way to continue it—the right way to bore a hole with a brace and bit is the wrong way to start the hole!

This contradictory doctrine is fully expounded in the photographs. In that showing the beginning of a hole to be made with brace and bit, the tool is seen held at arm's length, the position best adapted to allowing

Bit at an angle—wrong

Chisel at an angle—wrong

the workman to see that his tool is perpendicular with the hole he is to bore. On the contrary, if he continues to bore in this position, the alternate pull and push of the brace handle, as the tough fibers of the wood resist the cutting action of the blade and the action of the worm pulling the bit down, will speedily throw the hole out of true, if indeed it does not result in bending the bit. On the contrary, the position shown wherein the body is close to the brace is the proper one for boring, since, held in this way, the brace is steady and the pulling and pushing on the handle exerts a minimum effect on the position of the bit. Yet, to start a hole in this position is to have no certainty of its direction, and is also to waste strength, since no muscle is needed to start a brace and bit pulling, as long as the worm is sharp enough and cuts deep enough to pull the bit down. When the middle of the hole's depth is reached, it not infrequently happens that the resistance of the wood to further cutting is greater than the power of the wood to hold the worm, and then some pressure is necessary to keep the bit at work—this pressure can only be applied with the weight or push of the body, and can never result from such a posi-

Bit started straight—right

tion as is shown in the photograph where we show the right way to start but the wrong way to continue to use the tool.

Mending Porcelain

A BROKEN porcelain mortar can be repaired with shellac so that it will be satisfactory for light work. Warm the porcelain slightly, apply a layer of shellac to the broken edges, press them tightly together and bind with adhesive tape. Allow to dry for at least 24 hours before using.

Stirring Rods

THE amateur chemist often has use for specially shaped glass stirring rods but does not have them at hand. The difficulty can be overcome by making them with the assistance of some ordinary glass rods and a Bunsen burner. The end of the rod is carefully heated in the blue flame of the

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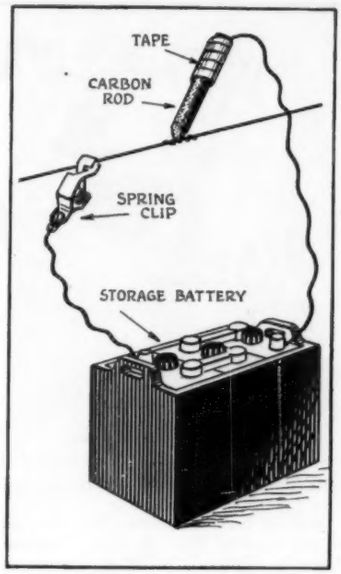
burner and then pressed into the required shape on an asbestos pad. Do not heat the glass to too high a temperature as it will become too fluid to be worked properly and will droop.

Soldering by Electricity

WHEN two electrical conductors are brought together in light contact, the joint will usually present a high resistance to the flow of a current. When this condition exists, heat is generated at the point of contact. It is quite possible to make use of the heat so formed and this is done on a large scale in such work as commercial electrical welding, wherein the conductors are touched and then separated to form an arc. Even the amateur can apply this principle to his own use, particularly in small soldering jobs.

A six-volt storage battery of the automobile-starting or radio type is usually part of every experimenter's equipment. This can be used in electrical soldering work. The wiring diagram is shown in these columns. Two heavy, flexible leads are fastened to the battery terminals. These should be no smaller than Number 10 and should be long enough to reach to any point where soldering is to be done. A strong spring clip of the type used for battery connections is fastened to one of the wires, making sure that a strong, tight joint is formed. The other wire is twisted firmly around one end of a carbon rod and the joint is covered with several layers of tape, in order to form a handle. The other end of the carbon rod, which rod should be at least six inches long, is now sharpened to a blunt point and the outfit is ready for use.

Let us presume that we are to solder a joint between two wires, as in the illustration. They are prepared for soldering in the usual manner and twisted tightly together. One of the wires is gripped in the spring clip and with the solder ready for application, the pointed end of the carbon rod is touched to the joint. An intense heat will be generated in a few seconds and the solder will flow readily. Never use this method for more than 10 to 15 seconds at a time as the current draw from the battery is high. For light work in soldering wires and thin metals, this length of time will be found ample.



A storage battery may be used to furnish the current used for light electrical soldering. This system must not be used for long periods of time as this will tend to ruin even the best battery

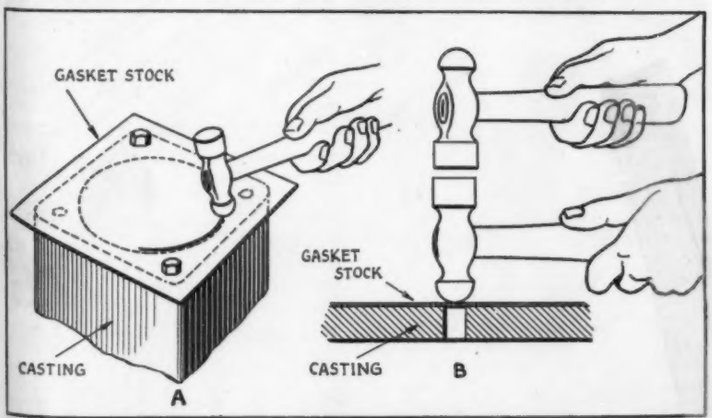
Gaskets

IN many forms of mechanical work, gaskets are invaluable. With their aid, the model maker obtains higher efficiency from his model steam engine; the automobile mechanic makes air and water-tight joints and the home handyman is given assistance when repairing some part of the plumbing. Often there is a demand for a gasket of an odd size that cannot be obtained readily, or work is being done at times when stores are not open. Then the mechanic is faced with the problem of cutting his own gaskets and, if the proper procedure is not followed, trouble ensues.

Under ordinary conditions, gaskets are easy to cut. However, one should never place a sheet of gasket paper or other material over the casting that the finished gasket is to cover, and attempt to outline with a pencil the parts to be cut away and the holes to be cut. In almost all cases, the procedure illustrated in these columns can be followed and the result will be perfect fitting gaskets, produced with a minimum of time and labor.

When cutting gaskets from paper or cork stock, place the sheet over the surface and with the rounded end of a ball-peen hammer, carefully tap around the edges of two of the bolt holes. The action of the hammer on the gasket material will cause the latter to be cut on the edges of the metal casting. In the two holes so formed, insert bolts so that the material will be held in position for the rest of the process. Now cut the remaining holes in a like manner and work around the outer edge of the entire gasket. All the necessary holes can be cut in this manner and the edges will be found free from fuzz and raggedness. The process is shown at A in the illustration in these columns.

The preferred method for use when cutting gaskets from materials that are harder to work than paper, is shown at B in the illustration. Here the material is placed over the casting as described above and a ball-peen hammer is laid on it, over one of the holes. This hammer is then struck with another one. This system allows very accurate location of the holes to be cut and produces the best results with thin sheet metal, felt, asbestos, et cetera.



Where special gaskets are necessary, they can usually be cut to an exact fit by using one or the other methods illustrated. These are of particular value to those who do their own repair work on automobiles

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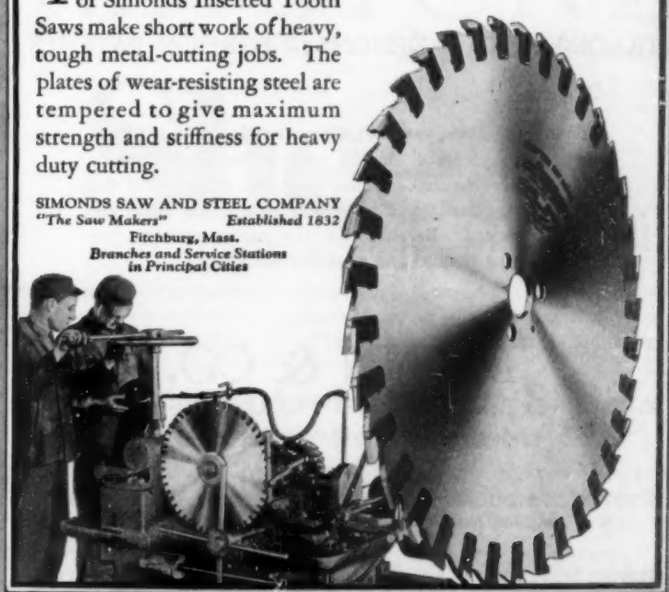

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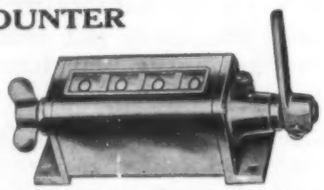
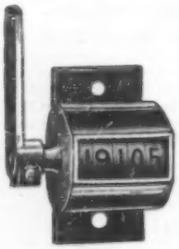
The large Set-Back Revolution Counter at right is less than ¾ actual size. The small Revolution Counter below is shown nearly full size.





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The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

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California Amateur Makes Interesting Telescope

Working from the instructions presented in the Scientific American book, "Amateur Telescope Making," Mr. R. G. Adams, an automobile dealer, 144 West Amerige, Fullerton, California, has completed a telescope having a mirror ten inches in diameter. At our request Mr. Adams submitted the two photographs reproduced in these columns, and the description which follows:

Scientific American,
Gentlemen:

Working from your original article on amateur telescope making, and the book on the same subject for which I subsequently sent, I have produced the ten-inch reflector pictured in the accompanying photographs. Most of the machine and lathe work was done in the local high school during the evening classes which were in session two nights a week.

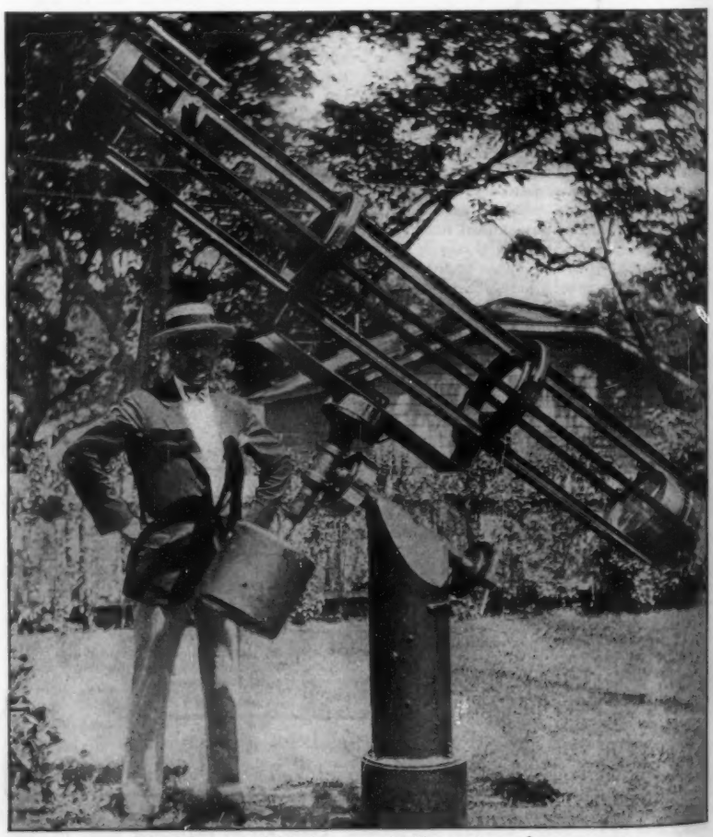
Ford rear axle housings and the "T" to allow adjustment of the declination axis, as described by Mr. Ions, in "Amateur Telescope Making," were used. But here the similarity with the Ions mounting ceases. The "T" was set flush against the plate and welded in order to secure greater rigidity, and 1¾-inch shafts with bronze bushings were substituted for the Ford axles at both ends.

Nickel-plated Ford brake drums were engraved for circles and for the verniers to bring the reading down to even minutes on the hour axis as well as the declination axis. The lower end of the hour axis was lathed to one and one sixteenth inches and threaded to take a jam-nut which, when tightened, holds the gear in contact with a clutch. Thus it receives the drive from the motor mounted in the base.

Since the photographs were taken two Ford brake drums have been added. One was inscribed with a vernier, so as to allow thumbscrew locking to the gear, and the other was marked in hours from zero to twenty-four. It is possible to slide both of these bands and, after focusing on a known bright star, to lock them at the right ascension of that star.

With this arrangement no sideral clock is necessary, nor is it necessary to use any calculations to locate any other astronomical object—the moving of the tube to any other right ascension reading brings the object immediately into the field of view.

The motor which furnishes the driv-



Mr. Adams and his home-made Newtonian telescope

ing power for the right ascension axis, is a sewing-machine motor geared through a three-to-one pulley, and then through three 100-to-1 worm gears. It is regulated by a 75-watt lamp cut in series with the current supply, and further regulated by a governor from an old phonograph. The "close-up" shows the driving motor mounted in a piece of discarded well-casing, ten inches in diameter, with the motor below and the clock-work above. The base is provided with slotted holes for the bolts, allowing adjustment of the entire mounting.

The declination axis is provided with a slow motion controlled by a grip wheel at the upper end, as shown, the action being that of a small moving gear walking around a large gear bolted to the housing. The friction in this train of gears and the friction at the clutch on the hour axis eliminates the necessity of the Ford brake arrangement used by Mr. Ions.

The tube is an open framework, formed of six eight-foot lengths of 1¼-inch "I" iron, welded to four brake drums with the center lathed out. The entire tube is carried in "U" shaped bands in order to allow rotating for convenience. The open-work tube is designed to reduce the effects of air currents.

The mirror is of 90-inch focal length and is 10 inches in diameter. It is so slightly parabolized as to be almost negligible. With no cover except one made of top material (auto) and the rapid fall of our temperature in California after nightfall I have found that a figure in the nature of a sphere performs better that any other. [The effect of falling temperature is temporarily to deepen the curve.—EDITOR]

The total cost, including finder and five Bausch and Lomb eyepieces, was a fraction under 300 dollars. Much of this cost was expended in the change to heavier shafts after the Ford axles were found to be too light.

The maker submits his photo as a part of the scene for size comparison, as well as in response to your recent request.

May I thank you for putting me on the road to many pleasant hours, not only for myself but for the many friends as well who are enjoying them with me.

R. G. Adams.

Details of the mounting and drive of the Adams telescope

"A Little Nonsense . . . ."

Once in a great blue moon someone sends us a sane communication concerning the cosmic ray recently analyzed by Millikan. Otherwise, we think nothing in the scientific world has been so provocative of curious hypotheses, none of them any too well baked, as the announcement concerning this ray, made about a year ago by Millikan. If we have received one, we have received a hundred, letters claiming priority of discovery of the cosmic ray, said discovery in each case having been made, we fear, mostly in the imagination of the claimant. Herewith we publish a series of verses whose author, by the way, is obviously acquainted personally both with the cosmic ray and the ultimate atom. These verses stand in refreshing contrast to the kind of thing alluded to. We think they are clever:

The Cosmic Ray and the Ultimate Atom

The Cosmic Ray and the Ultimate Atom
met on a crowded street,
Said the Ray to the Atom, "Hey, hello!
we've got no business to meet,
For if I hit you a mite too hard—and
it's true what the scientists say—
There'll be a reverse of the universe,
and a hole in the Milky Way."

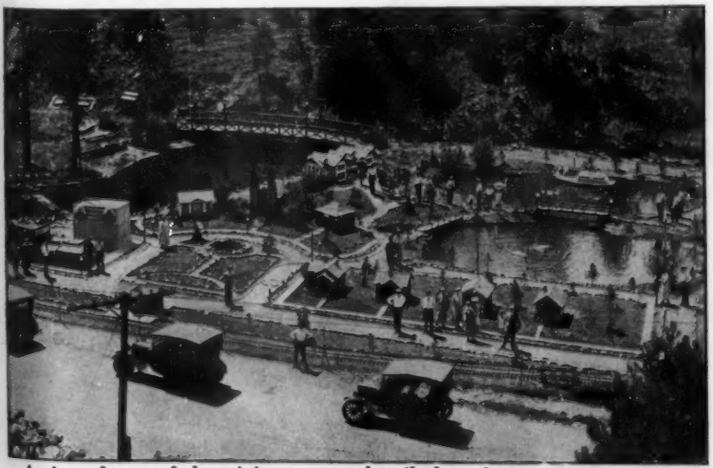
Said the Ultimate Atom to the Ray,
"You're talking into your hat.
I am the guy they are searching for,
and the thing they are peering at;
I can do all the work of the world myself—if it's true what the scientists say—
Or cause the reverse of the universe,
and the hole in the Milky Way.
But what they are muddling their brains
about—for none of them really
know—
Is what in the world, or the devil's
name *will* happen if I let go?"

The Cosmic Ray arose in his wrath; he
was mad as a mad wet hen,
He hit the Atom a good, hard sock, and
then—and then—and THEN!
The red light winked, and the green
light glared; with the spell of
the red light spent,
I haven't the ghost of a dead idea where
the Ray and the Atom went.

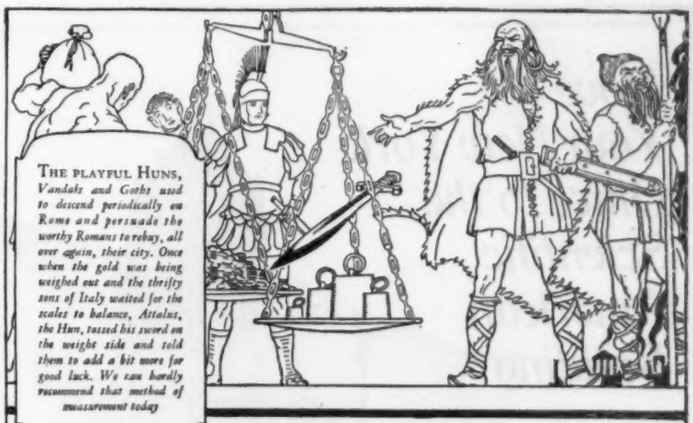
M. C. Skeel,
Westerville, O.

Tiny Town

An architect of Colorado has built, evidently as a hobby, a miniature town that is complete in many of its details. It is so interesting in its entirety that it is the



A view of part of the miniature town described on this and the next page. A narrow-gage railroad track runs along the roadway



THE PLAYFUL HUNS, *Vandals and Goths used to descend periodically on Rome and persuade the worthy Romans to buy, all over again, their city. Once when the gold was being weighed out and the thrifty sons of Italy waited for the scales to balance, Attalus, the Hun, tossed his sword on the weight side and told them to add a bit more for good luck. We can hardly recommend that method of measurement today*

Any instrument that gives man a standard of measurement must be

DEPENDABLE

The fabric of national and business life today is trust—whenever that trust is betrayed we have wars, strikes and revolutions. Accuracy and honesty enter even more vitally into the complicated balance of physical health and the intricate process of modern manufacture; a few degrees difference in temperature are the difference between human life and death; and in industry the difference between successful manufacture and ruin.

The manufacture of instruments which record and control so important a thing as temperature must be like Caesar's wife. The fact that today most of the scientific instruments made in this country for such purposes are made by *Tycos* is an indication of the reputation earned by this company over a period of seventy years.

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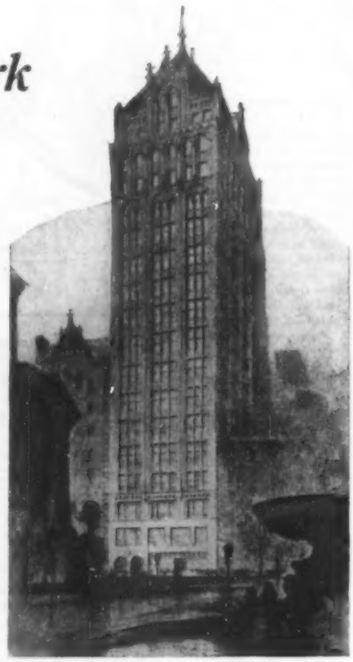
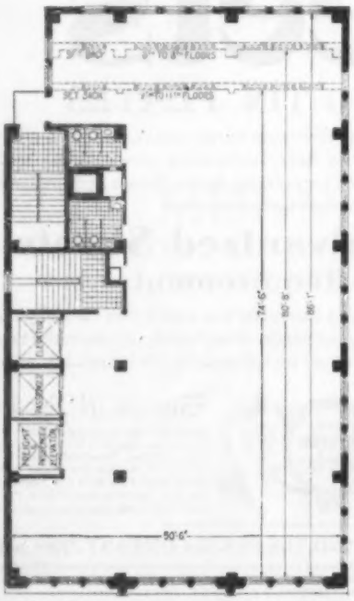
Move Your New York Office to the Scientific American Building



A new 16-story building—the Scientific American Building—has been erected on one of the most desirable office sites in the United States—at 24 West 40th Street, New York City.

Open to the sunlight on three sides, it is a half block west of Fifth Avenue and a block and a half east of Broadway. Across the street lies Bryant Park and the New York Public Library. It is four blocks from the Grand Central Station and eight blocks from the Pennsylvania Station.

Neighboring buildings include the American Radiator Building, the Engineers' Club, the New York Club, the National Republican Club and the Engineering Societies.



Should you be considering offices in New York City by all means investigate space in this attractive building—accessible, distinguished, desirable—and at rents which are reasonable.

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The library and church of the tiny town described. The size of the buildings may be determined by comparison with the people in the photograph

Mecca of tourists who pass through that section of the country. The following description of the town was submitted by one of our readers:

Editor, Scientific American:

An unique tiny town in Turkey Creek Canyon near Denver, Colorado, built and owned by George Turner, millionaire architect, is visited by thousands of tourists every year from all over the world.

With its paved streets, picturesque hotel, church, library and stores, the town, at a distance, looks real enough to be mistaken for a genuine mountain village. The little city contains two small pools of water, representing lakes on which float small boats and swans. A number of beautiful bridges span the lakes and graveled paths wind about the city. A little civic center occupies the main part of the town, on which are beautifully laid out flower beds.

A two-spired cathedral, library, a filling-station, garage, grocery store, barber shop, pool hall and hotel, are the principal buildings of the tiny mountain village.

A miniature railroad runs through the town, with a small yet complete station. Electric lights adorn the paths, parks, lakes and streets, making a beautiful sight at night.

Frank S. Reynolds,
Fort Morgan, Colorado.

Anent the Road Corrugation Question

In the letter published below, our correspondent disagrees with the opinions published previously on this interesting controversy. He suggests an entirely different reason.

Editor, Scientific American:

Interest in previous opinions re corrugation of roads (published in these columns in the September and November issues), prompts me to contribute my answer to the problem.

In this part of the west, our roads are nearly all macadamized or graveled and only in the last few years have they been tarred or oiled to any extent.

The even ripples or corrugations aroused my curiosity and my observations lead me to the conclusion that they are caused by the driving or rear wheels of motor cars. Sudden acceleration of the engine causes the wheels to rotate so fast that the tires do not grip. The result is a gouging action. A sudden grip immediately brings the springs into action and the up and down movement of the car causes a succession of gouges until the proper momentum is obtained.

I do not believe that road-making or scraping, much less braking, has anything to do with road corrugation.

J. B. Adams,
Victoria, B. C.

1,800 Amateur Astronomers

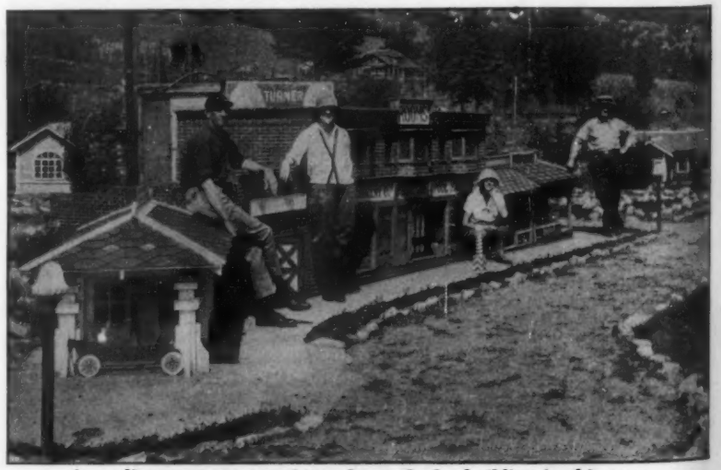
The interest in making telescopes at home which we aroused nearly a year ago keeps up as strongly as ever. So far, we have traced nearly 1,800 amateur enthusiasts who have made telescopes or indicated their intention to do so. The following letter is from one of the latter:

Editor, Scientific American:

I am a junior at Macalester College and am majoring in mathematics and physics, but my deepest interest is and has been in astronomy. Owing to my school work, it will be impossible to start work on a telescope immediately, but I intend to study up on the subject so as to be able to start quickly and intelligently when I do get the opportunity.

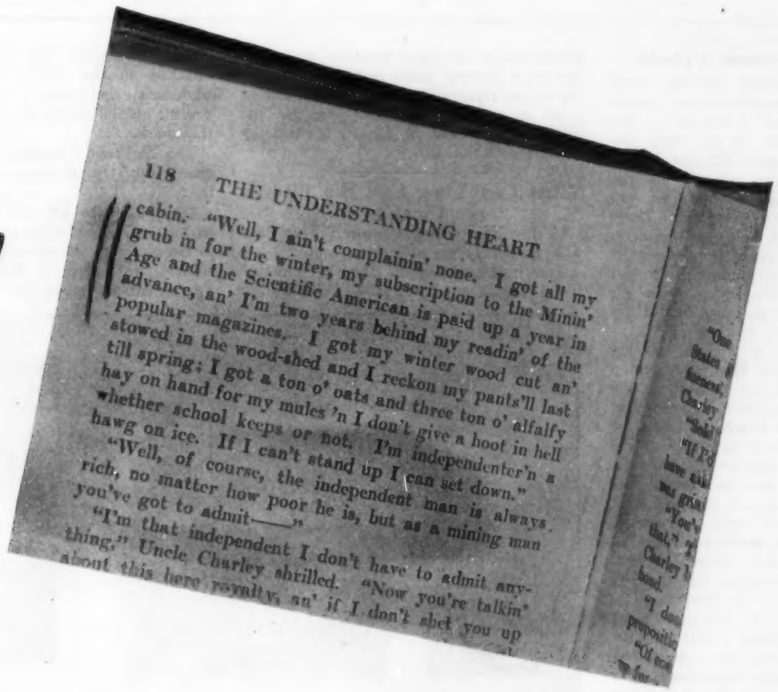
I have an excellent 3.5-inch refractor with driving clock and setting circles, but I am hoping to make an instrument superior to this eventually. Your articles on telescope making are very interesting and I hope they will continue.

Yours respectfully,
William A. Calder,
St. Paul, Minnesota.



An ordinary person can sit on the roof of a building in this town

Completely Equipped


118 THE UNDERSTANDING HEART
cabin. "Well, I ain't complainin' none. I got all my grub in for the winter, my subscription to the Minin' Age and the Scientific American is paid up a year in advance, an' I'm two years behind my readin' of the popular magazines. I got my winter wood cut an' stowed in the wood-shed and I reckon my pants'll last till spring; I got a ton o' oats and three ton o' alfalfy hay on hand for my mules 'n I don't give a hoot in hell whether school keeps or not. I'm independenter'n a hawg on ice. If I can't stand up I can set down."
"Well, of course, the independent man is always rich, no matter how poor he is, but as a mining man you've got to admit——"
"I'm that independent I don't have to admit anything," Uncle Charley shrilled. "Now you're talkin' about this here royalty, an' if I don't shet you up

With his grub in for the winter, his pants in condition to last until Spring, and the Scientific American paid up for a year, Uncle Charley is sitting on top of the world. All the necessities of life are taken care of.

A wise man is this shrewd old mining prospector described by Peter B. Kyne in his latest novel, "The Understanding Heart." What more can the representative of an Eastern mining concern with one hundred and fifty thousand dollars in his hand add?

Like thousands of men in real life, Uncle Charley classes the Scientific American among the essentials. Reading it is their hobby—a hobby which not only is a fascinating pastime, but one which enlarges their view, adds to their knowledge, gives them a bigger, better, clearer understanding of what is going on in the world about them.

They are not content with reading it now and then; they must have it every month. Nor are they willing to risk missing it on the news stands; it is no uncommon experience, they have learned to their sorrow, to find the news stands sold out of Scientific Americans.

Why not follow their example? You have read the Scientific American and like it. The more you read it, the more you will enjoy it. Reading it regularly and consistently will prove a liberal education. Don't take a chance on trying to buy it only when you happen to think of it.

Do like Uncle Charley. Send in your subscription now and insure this prime necessity of life. It will cost you only $3 for the rest of this year. Do it now.

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Wood Wheel Patent Upheld

THE Kendrick all-wood steering wheel for automobiles, airplanes and motorboats is held valid and infringed by the Circuit Court of Appeals for the Sixth Circuit in the suit brought by the Inland Manufacturing Company, a unit of the General Motors Corporation, against the American Wooden Rim Company. There was little or no dispute as to infringement, the only question presented by the appeal being as to whether producing an all-wood wheel of sufficient strength to resist all sudden and heavy stresses constituted invention. As to this the court says:

"If the production of an all wooden steering wheel did not involve invention there would have been no purpose in the Cadillac Company requesting the exclusive right to the use of the Kendrick wheels for one year, and no theory upon which the appellee could have guaranteed such exclusive use. If other steering wheel manufacturers could make an all wooden wheel and sell the same to other automobile makers, it could have made no difference to the Cadillac Company whether the appellee or other manufacturers sold its competitors. Under such circumstances, its exclusive right to use the Kendrick wheel for a year would have been worthless. That it did request and accept the right to the exclusive use of the Kendrick wheel for a year strongly tends to prove that it believed the production of such a steering wheel involved invention.

"It is no argument against invention that the inventor availed himself of all knowledge known to mechanics skilled in the art, nor is it surprising that when a definite result has been accomplished that the simplicity of the methods by which it is accomplished would seem to be obvious. The line between the skilled mechanic and the ingenuity of the inventor cannot be accurately drawn in any given case, but where a demand has long existed and men skilled in the art have sought to meet that demand without success, the argument that the methods employed by the inventor who has solved the problem are so obvious as to involve only mechanical skill, is not entitled to very serious consideration."

The Trademark "Uncle Sam"

THERE are many uncles, but none of them are like Uncle Sam, the Patent Office believes. "Uncle Sam" is a trademark for work-shirts made by Salant and Salant, Inc. When they discovered that Feldman and Weinman had registered the mark "Sammy" for shirts, they demanded that it be cancelled, declaring the public would be confused. First Assistant Commissioner Kinnan refused to cancel it, however, saying:

"If the names involved in the two marks were Uncle Bill and Billy, respectively, or Uncle Jim and Jimmy, respectively, it would seem proper to hold that if the later in the field had adopted the mark Billy or Jimmy probably confusion would be shown and the petition should be sustained. The notation Uncle Bill or Uncle Jim would not refer to any particular individual and there are many persons to whom such a designation could apply. Purchasers would readily, as stated by the examiner of interferences, use both names indiscriminately.

"The petitioner's mark, however, would be readily understood by the average purchaser as indicating that mythical character well known as symbolic of the United States Government or of the United States. The mark 'Uncle Sam' is used in connection with a representation of this distinctive and characteristic mythical individual. The respondent, on the other hand, has registered the word 'Sammy' alone and there is nothing in its registration or in its notation or mark as actually used that suggests the mythical individual or his designation by petitioner's notation."

What Can They Call the Flivver Cigar?

AT last Henry Ford is famous. They have named a cigar after him.

The trademark which Daniel Newberry Floyd sought to register as a trademark for the cigar was a picture of an automobile with the word "Henry" over it. Henry Ford and the Ford Motor Company, however, objected, saying the mark was in effect merely the name Henry Ford. First Assistant Patent Commissioner Kinnan agrees with them, and inasmuch as personal names are not registrable as trademarks, refuses to register the mark.

These are royalty stamps such as inventors and manufacturers used 50 years ago. A manufacturer would license a patent from an inventor at a stipulated royalty of so many cents for each article in whose manufacture the invention was used. The inventor simply sold the stamps to the manufacturer and one was placed on each article. No accounting system was necessary

Seams to be Patentable

HOW small an invention can be and yet be entitled to a patent is illustrated by the recent decision of the First Assistant Patent Commissioner in overruling the Board of Examiners and issuing a patent to Frank Bloise and Frank Reda for cutting a pattern for a coat in such a way that the stripes in the goods match at the seams joining the collar and lapels.

"The change after what has gone before is admittedly small and seems an obvious one after it has been accomplished," he rules, "but it is clearly one making for marked economy and one which adds to the appearance of the garment. Should this method prove as appellants claim it has already been determined to be a popular mode of making the garment, the advantages are so apparent it would seem a fair conclusion there was something more than mere mechanical skill involved in the discovery and production of the method."

The Armand Girl

CAN you have more than one trademark for the same article? "Certainly," says Assistant Patent Commissioner Moore, affirming the decision of the examiner of interferences allowing registration by the Armand Company for face powders and other goods of a representation of a girl in the costume of an early French period.

Opponents had argued that the "Armand Girl" was not used as a trademark, as there were other trademarks on the goods to indicate their source; that the word Armand, attached to the goods, was a registered trademark, and that a silhouette, always present on the goods, also was a registered trademark.

The Assistant Commissioner defines succinctly the steps necessary for registry, saying:

"It appears to be well settled law that to acquire a good title to a trademark, it is necessary to do three things: First, the trader must adopt a trademark open to appropriation; second, he must apply it or attach it physically to a vendible commodity; and, third, he must actually put the commodity so marked upon the market. The offering of the goods for sale to the public is necessary, if no actual sale takes place."

Slogan Denied Registration

REGISTRATION of the slogan "Every Drop Delicious" is denied the Nash Coffee Company by First Assistant Commissioner Kinnan on two grounds: First, that the slogan is descriptive, and, second, that the trademark use of the slogan has not been shown.

"To the average purchaser," he rules, "it would mean merely a laudatory statement to the effect that every drop of the coffee was good. It is not believed the Act [of March 19, 1920] was intended to or does by its terms provide for registration of such descriptive phrases when used solely in their descriptive sense."

Misleading Names Are Forbidden

IF you misname your product, you are likely to get into trouble with the Federal Trade Commission. Here is a statement it recently issued:

"The Synthetic Products Company, of Cleveland, Ohio, is named in a cease and desist order issued by the Federal Trade Commission today. According to the findings, the company manufactures under a secret formula a compound for use in softening and rendering rubber more resilient, and designates the compound in its advertisements and business stationery as 'Liquid Rubber' when such is not the fact.

"This practice," continues the findings, "has the capacity and tendency to mislead and deceive purchasers of the compound by causing them to believe that the compound is composed of rubber, thereby diverting trade from competitors of respondent who truthfully designate and describe their products."

"Wheat-Nut" and "Grape-Nuts"

WHEN the Farmers Mill and Elevator Association recently sought to register "Wheat-Nut" as a trademark for breakfast foods, the Postum Cereal Company opposed it on the ground that it was similar to the trademark "Grape-Nuts" and would deceive purchasers. The Postum Company reminded the Commissioner that "Bran-Nuts" had been refused registration because it was similar, while the Association reminded him that "Fig-Nuts" had been registered as not similar.

In allowing the registration Assistant Commissioner Moore considered that "Wheat-Nut" was accompanied by a picture of a small boy in kilts holding a big spoon in one hand and a steaming dish in the other.

"As the words 'Grape-Nuts' and 'Wheat-Nut' are dissimilar," he ruled, "and as the opposer's mark contains no pictorial characteristic corresponding to that of the applicant's mark, it is believed that the two marks do not so nearly resemble each other as to be likely to cause confusion or mistake in the mind of the public or to deceive purchasers."

Mixups in Telegrams

"REPORT in Washington at our expense," a business house wired a field agent. When he appeared he presented a bill for his railroad fare. When the company declined to pay it he showed the telegram. It read "at our expense."

Frequent errors of that kind have impelled H. C. Smithers, Chief Coordinator of the Bureau of the Budget, to issue to the heads of Federal departments and establishments, instructions designed to prevent the use in telegrams of words of similar spelling but opposite meaning. Examples of such words are "now" and "not" and "our" and "own." In the case cited above the error could have been avoided by writing the message "at *personal* expense."

Another source of misunderstanding is in the case of dispatches in which punctuation plays too important a part, when the omission of a comma or a period may change the whole sense. If such a dispatch cannot be rephrased so as to avoid ambiguity, the words "period" or "comma" should be inserted, where the punctuation is a vital factor.

Substitution May Be Invention

IS the substitution of one material for another a patentable invention? It may be, says the Board of Examiners of the Patent Office, reversing the rejection by the examiner of the application of Giulio Schroeder. The patent, No. 1,602,947, is for an improvement in frames for dynamo electric engines. Heretofore the frames have been of metal; Schroeder substitutes concrete.

Says the Board:

"In considering the matter of substitution of one material for another, it is pertinent to inquire why the old material has been employed and whether those skilled in the art would consider it practical or feasible to substitute the new material in place of the old. For years heavy metallic frames have been employed, and apparently no one has suggested the use or substitution of concrete therefor. The advantages of reinforced concrete as a building material in certain kinds of structures is well recognized, and the fact that no attempt at such substitution was made for a great many years, warrants the conclusion that those

skilled in the art had considered the use of cement in this relation as of doubtful practicability.

"Where an art has grown up along a certain line and those skilled therein have adopted a principle as if it were necessary, the person who has the initiative and the audacity to depart from that principle has done something not obvious, and, ordinarily, he is entitled to a patent. In view of the above considerations, we are in doubt whether the substitution of concrete for iron in a stator frame for dynamo-electric machines was an obvious thing; and, being in doubt, the question of patentability should be resolved favorably."

Trade Commission Changes Policy

THE Federal Trade Commission has changed its policy so that complaints begun by the Commission will be made public when served upon respondents, instead of waiting, as heretofore, until after an answer has been filed or the time limit for an answer has been reached.

It is stated at the White House that the President recognizes that there may be times when publicity concerning an unfair trade citation in advance of the filing of an answer thereto might result in some injury. He does not, however, feel that such injury would be lasting unless deserved, and he is of the opinion that business in general should realize that when any concern is engaged in unfair practices the Commission is fully justified in doing everything possible to prevent its continuance.

An Echo of the Ponzi Bubble

DO you recall Charles Ponzi and the excitement he caused with his mysterious method of multiplying money invested with him? An interesting legal point has just been decided in connection with his case—the question of whether or not an innocent representative of a faker can collect for services which helped a fraud.

The claimant is Clemente Viscariello, who believing in Ponzi, sold his notes for him on a 10 percent commission. The Referee in Bankruptcy refused to allow him to prove the notes on the ground that the payments of commissions by Ponzi were transfers in fraud of creditors, and therefore must be returned before the proof could be allowed.

"The situation is one in which one of two innocent parties must lose, and the argument is that the act puts the loss on the person who dealt with the fraudulent bankrupt," says Judge Morton, upholding the trustee on appeal. "The claimant's honest belief that his services to Ponzi in selling the latter's notes were valuable does not alter the fact that those services were not valuable, but, quite the contrary, were actually detrimental, because they furthered the commission of a crime, and deepened Ponzi's insolvency."

Co-operation Research

THE Bureau of Standards at Washington announces that industries in the United States are spending nearly a half million dollars each year on co-operation research at the Bureau. This is done under the "research associate plan," whereby a manufacturer or association places a graduate physicist, chemist or engineer at the Bureau to carry on investigation in some particular line. The plan has proved valuable, both in the training of additional research specialists and in maintaining the research output of the Bureau in lines which are of especial industrial importance.

A Customs Nut Decision

WOULD you say that peeled olive-seed kernels are shelled nuts? No? Well, the Treasury Department says they are. They are used by Chinese confectioners in cake making in the same way as almonds are used. They are beginning to be imported and a classification is necessary for customs purposes. The tariff is 1 percent per pound. Salted and roasted watermelon seeds, also, by the way, are classed as nuts.

What Is Personal Service?

IS the work of an undertaker personal service? Not for purposes of computing an income tax, the Board of Tax Appeals holds, in denying the contention of H. F. Suhr and Company, licensed embalmers in San Francisco.

"Supplying caskets and funeral materials and accessories, embalming the dead, furnishing automobiles, and rendering the other services enumerated by the petitioner are all inseparable parts of a single business," says the Board.

A Turkish Museum of Commerce

THE Turkish Ministry of Commerce is reported to have established a commercial museum in Stamboul for the benefit of native business men and manufacturers as well as to interest foreign tourists. Tobacco, rugs, textiles and minerals are featured. An innovation, surprising to visitors who recall the fez-wearing days preceding the Republic, is a display of felt hats manufactured at Karassy.

Extending a Patent

READERS frequently write the editor of this department asking information about patents. Often these questions are of general interest. The following is one of them.

Dear Mr. Wright:

Is it possible to extend a patent beyond the regular seventeen year period? A man may be ahead of his time and devise something of real importance to industry, but he may have to wait several years for industry to get to a point where it can make use of his invention. In such a case he really would not be getting the seventeen years benefit the law intended he should enjoy.

J. A. B.

Patents may be extended only by Act of Congress. This power was exercised as far back as 1808. It is only in rare cases, however, that Congress grants an extension.

The patent act of 1790 provided that under certain conditions patents might be granted for a term not to exceed 14 years. The act of July 4, 1836, provided for extensions, usually of seven years. The act of March 2, 1861, made the term of patents 17 years and prohibited extensions of patents granted after that date. The last extension under the act of 1836 was in 1875 and expired in 1882.

The only mechanical patent granted since March 2, 1861, which has been extended was the patent on Henrietta Cole's fluting machine, granted June 12, 1866, and extended seven years from June 12, 1893, by Act of Congress approved August 4, 1886.

Those Bad Descriptive Trademarks

"DEEP Sea Salt Water Oysters" is not registrable as a trademark for oysters, Commissioner Robertson rules in denying the application for the J. and J. W. Ellsworth Company, since the words merely indicate a kind of oysters and thus fall within the same category as "Semi-made" for dresses and "Toledo—No Springs—Honest Weight" for scales, ruled upon heretofore.

Thirty Days for Oppositions

UNLESS a notice of opposition to the registration of a trademark is filed within 30 days after publication, it cannot be filed at all. So rules Patent Commissioner Robertson in the petition of the Esso Manufacturing Company.

"The statute gives the commissioner no authority to institute opposition proceedings where the notice of opposition is filed after the 30 days," he holds. "The reasonable time referred to by the petitioner relates not to the filing of the opposition within 30 days, but to the verification by opposer where the notice of opposition was filed within the 30 days by an attorney."

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

SHOE.—A cushioning device which may be applied to the bottom of a shoe, to give air space between the cushion portions, and prevent slipping. Patent 1605947. H. Heady, 234 W. 59 Place, Los Angeles, Calif.

GARMENT.—A union under-garment, the upper part of the leg sections being so designed and cut that the part removed may form gussets. Patent 1608436. E. E. Sensenbach and G. K. Kocher, Jr., c/o Kocher & Sensenbach, c/o White Haven Knitting Co., White Haven, Pa.

METHOD OF PRODUCING APPAREL ORNAMENTS.—Made complete and ready to be applied by forming a strip of material into independent pairs of oppositely disposed loops or frogs. Patent 1608430. A. Rosenberg, 1241 Oak St., Far Rockaway, N. Y.

Chemical Processes

METHOD OF PASTEURIZING CHEESE.—Which consists in grinding the cheese, mixing therein a little water together with ammonium tartrate and ammonium chloride, heating to 140 degrees and allowing to cool. Patent 1607064. E. E. Eldredge, 1620 Washington Ave., Wilmette, Ill.

COMPOSITION OF MATTER.—For the treatment of trees and plants to protect them from insects, the composition includes 20 percent calcium stearate, will not be effected by rain. Patent 1608390. A. S. Halland, c/o A. S. McDaniel, 51 E. 42nd St., New York, N. Y.

Electrical Devices

ELECTRIC WIRING SYSTEM FOR SIGNALS.—For the offices of doctors and the like, whereby visual and audible signs will be indicated upon the patient or customer announcing his arrival. Patent 1606404. F. V. Eastman, Washington Sanitarium, Takoma Park, Md.

FLOAT-OPERATED CIRCUIT CLOSER.—By means of which a signal will be given when a tank is either full or empty, and a reading of the level may be taken at any time. Patent 1607464. W. H. Kirby, Beverley, Mass.

TESTING METER FOR RADIO SETS.—Made in simulation of the socket end of the vacuum tube to be inserted facing upwardly, and may be turned for convenient reading of the dial. Patent 1606063. M. E. Edwards, 1512 Waller St., San Francisco, Calif.

AUTOMATIC DIAL DEVICES.—Whereby either of a plurality of signal impulses may be sent over a line, with the conventional sub-station mechanism, without interfering with normal operations. Patent 1609185. S. Pastor, c/o Compania de Telephons de Maracaibo, Venezulles.

ANTENNA.—So woven that it can be efficiently supported, and used in an ornamental manner with the decorations of a house interior. Patent 1609152. F. C. Carmel, c/o A. H. Rice Co., Pittsfield, Mass.

Of Interest to Farmers

BEEHIVE FRAME.—With means for incorporating wires which support the honey combs at proper tension to prevent sagging, and fit for brooding purposes. Patent 1607527. W. Grams, Sturgis, S. D.

PLANTER.—Having a shoe for forming a very narrow furrow to receive periodically deposited onion sets, and cover the same with soil. Patent 1607102. F. H. Schutter, c/o S. & H. Set Onion Planter Co., Pleasant Valley, Iowa.

CULTIVATING MACHINE.—For cotton or sugar beets, a vertically adjustable beam carrying scrapers spaced apart for thinning the rows of plants as desired. Patent 1608,675. C. M. Scott, 1529 Summit Ave., Memphis, Tenn.

REVERSIBLE PLOW.—With shares extending in opposite directions, one throwing a right hand furrow, the other a left, particularly useful in the cultivation of hillsides. Patent 1608198. A. Birrer, 572 20th St., Oakland, Calif.

Of General Interest

COMBINED HOLDER AND CONTAINER.—Which will serve for enclosing, among other things, vendable commodities, such as adhesive plasters, in a dust-proof and moist-proof condition. Patent 1606563. G. C. Deane, 7 Highland Place, Yonkers, N. Y.

WHIPPING GOLF CLUBS OR THE LIKE.—For finishing and securing the leather grip around the shaft, in such manner that the unwinding of more than one convolution is impossible. Patent 1606711. W. P. Levy, Box 184, Spreckels, Calif.

SCREEN FOR X-RAY PHOTOGRAPHY.—Consisting of a celluloid body having smooth surfaces, each face having incorporated therein fluorescent material, thereby giving longer wear. Patent 1606397. I. Bond, 1410 Chicago Ave., Evanston, Ill.

LID HOLDER FOR STAVE OR SPLINT BASKETS OR HAMPERS.—In the form of a U-shaped hook for use at various points around the rim band to prevent the accidental displacement of the lid. Patent 1606260. W. L. Pitts, c/o The Marshall Mfg. Co., Marshall, Texas.

FASTENING DEVICE.—Particularly adapted for use in holding a fire place front cover in place, the device can be adjusted within a considerable range. Patent 1606112. J. H. Sutton, La Grange, N. C.

PICTURE FRAME AND STAND.—Which may be held in an upright position or an inclined position and held frictionally without additional clamping devices. Patent 1606488. H. F. Wennerstrom, Fulton, Ill.

EXTENSION SLIDE FOR TABLES.—Which will prevent sagging at the central portion when the table is extended without the use of a central leg. Patent 1604457. C. O. Lowe, 30 Sycamore St., San Francisco, Calif.

CONVERTIBLE BAG OR RECEPTACLE.—For use as a pocketbook, hand bag, shopping bag or music roll, and in all its uses present a compact and attractive appearance. Patent 1606107. E. W. Simms, R. F. D. No. 3, Sparland, Ill.

COMBINED CURTAIN STRETCHER AND CLOTHES RACK.—Affording facilities for supporting a plurality of different sized curtains without the use of fastening pins, or for supporting garments, as a costumer. Patent 1606401. E. M. Craft, 1663 E. 85th St., Cleveland, Ohio.

CLAMP ATTACHMENT FOR BEDS.—Which affords facilities for holding bed clothing or coverings smoothly against the foot end of the mattress of the bed. Patent 1606367. A. B. Holt, 630 Maple Ave., Grafton, W. Va.

WELL-CEMENTING DEVICE.—Designed for cooperation with a single valve sent in the well casing in such manner as to insure a proper seal under all circumstances. Patent 1606206. A. Boynton, c/o Frontier Oil Co., City National Bank Bldg., San Antonio, Texas.

COTTON-BALE PATCH.—Which can be quickly placed in position to close an opening in the bale cover, and will retain its form under ordinary pressure. Patent 1607406. I. Margolius, Box 27, Debree Sta., Norfolk, Va.

FOLDING COMB.—With hinged joint, which functions to automatically lock the sections in open relation when they are swung to an opened condition. Patent 1607564. M. Rabb, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

BOTTLE HOLDER.—By means of which bottles can be more readily held and manipulated to carry on certain action in spraying poison. Patent 1607053. G. E. Buchanan, 112 Cotton Ave., Box 77, Americus, Ga.

COORDINATED MIRROR.—Adapted for use by barbers or hairdressers so that the per-

son receiving treatment may inspect the appearance of the work back of the head. Patent 1607163. H. L. Kinter, Curran, Ill.

BEVERAGE DISPENSER.—Which affords facilities for keeping the beverage at a temperature which may be sufficiently low to cause partial congellation when served. Patent 1607347. N. Hemman, 3570 Pershing Ave., San Diego, Calif.

HEAD FOR TOYS.—Such as dolls and the like, with eyes which can be moved to relatively different positions by tilting or shaking the head. Patent 1607570. M. H. Slater, c/o Munn, Anderson & Munn, 24 W. 40th St., New York, N. Y.

SPRINKLER.—That will evenly distribute water in a fine spray over an extended area in such manner that all parts may be equally watered. Patent 1605325. C. A. Borgeson, 3521 18th St., San Francisco, Calif.

PERFORATING, SEALING AND MEASURING DEVICE.—Comprising a perforating instrument for cutting a can and forming a pouring opening, and also serving as a closure for the opening. Patent 1606527. J. C. Hanes and C. C. Gogle, 1524 Bush St., San Francisco, Calif.

VENTILATOR.—Which is adjustable to regulate the flow of air into a theatre or like building, the air being discharged under the seats. Patent 1607092. B. R. H. Lyon, Buena Plaza Apt., 4363 Kenmore Ave., Chicago, Ill.

SECTIONAL BED.—Capable of being converted from a couch to a double bed, and having mechanism for raising, lowering and supporting the mattress. Patent 1608410. V. Massecese, 476 9th Ave., New York, N. Y.

VANITY CASE.—Having a compartment for dispensing loose powder, feeding the same in proper amounts to the puff without permitting spilling. Patent 1608449. F. B. Wendel, c/o Hercules Novelty Mfg. Co., 126 South St., Newark, N. J.

SKYLIGHT CONSTRUCTION.—Of simple and durable construction, a window frame, similar to the frames used in hot-houses, being connected with a suitable supporting frame and the roof. Patent 1608381. E. Flag, 111 E. 40th St., New York, N. Y.

PARASOL BAG.—Which can be used as a parasol, or readily adapted for use as a bag for holding bathing suits, bathing shoes or similar articles. Patent 1608394. B. L. Henry, Imperial Hotel, 32nd St., and Broadway, New York, N. Y.

TICKET CABINET.—Of compact and simple construction, at the same time having large capacity, and allowing of the separate dispensing of the tickets. Patent 1605145. H. N. Richards, 1521 El Prado St., Torrance, Calif.

PERPETUAL CALENDAR.—By means of which the day of the week upon which a given date falls, may be rapidly and accurately ascertained where the Gregorian calendar is used. Patent 1608411. T. J. Mateju, 323 E. 61st St., New York, N. Y.

DISPLAY FIXTURE.—Which will be self-accommodating to compensate for the various thicknesses of glass partitions, and will hold the glass against vibration. Patent 1608401. C. W. Kress, c/o S. H. Kress & Co., 114 5th Ave., New York, N. Y.

HATCH AND COVER.—May be readily applied and removed, adapted to different kinds of coamings and having adequate strength to resist downward pressure of cargo. Patent 1607767. A. N. McGray, 963 Main St., Agawan, Mass.

Hardware and Tools

TOOL HOLDER.—By which the tool point may be adjusted at any desired point on a lathe, and is characterized by rigidity between the head and shank. Patent 1606718. H. N. Orup, 1115 Bergen St., Brooklyn, N. Y.

MITER BOX AND HANDSAW GUIDE.—Adapted to serve as a gauge for a saw when cutting miter joints, hip rafter angles, or other angle cuts in lumber. Patent 1606703. H. C. Houser, 3308 Lindell Blvd., St. Louis, Missouri.

SUSPENSION HOOK.—Well adapted for porch swings and the like, so constructed that the pivot bearings are immersed in a lubricant, and noiseless. Patent 1606273. J. Tancin, Box 57, Upper Lehigh, Pa.

SAMPLING TOOL.—For obtaining oil samples from tanks, may be used at any depth, easily adjusted, easily opened to take the sample therefrom. Patent 1606104. W. A. Schlueter and A. Schillinger, c/o Refinery Supply Co., 4th and Detroit Sts., Tulsa, Okla.

SLEEVE TWISTER.—Designed to employ dies of various sizes, whereby the dies may be used to twist tubes of different diameters. Patent 1605958. W. J. Leach, 715 Pine St., Burlington, Wis.

ROTARY REAMER.—Capable of a very high degree of power, so that the blade may be thrust against the surface with the necessary power under all conditions. Patent 1607662. A. Boynton, c/o Frontier Oil Co., San Antonio, Texas.

DOOR CHECK AND CLOSER.—By means of which, when the force exerted on the door to open it is withdrawn, the action of a wound-up spring will close it. Patent 1605256. W. E. McAboy, Box 85, Palo Alto, Calif.

Machines and Mechanical Devices

METHOD OF AND MACHINE FOR MAKING LAMINATED DRUMS.—To be made in cylindrical or other hollow forms, in which the paper will be wound true after the initial adjustment. Patent 1606557. H. L. Carpenter, 137 41st St., Brooklyn, N. Y.

AUTOMATIC SELF-SERVING BUFFET.—Wherein a single power moved carriage is utilized to carry to different points containers having food ordered by different patrons. Patent 1606627. W. Gromer, 516 W. 142nd St., New York, N. Y.

DEVICE FOR STEAMING AND FOR STRETCHING OR SHRINKING TUBULAR FABRICS.—Particularly knitted tubular fabrics, resulting in a uniform stretching of the fabric without any distortion of the design. Patent 1605955. M. M. Kasanof, 3190 Rochambeau Ave., New York, N. Y.

PROCESS FOR PRODUCING LAMPBLACK.—From old automobile tires and casings and the waste lubricating oil drained from crank cases by burning and cooling the smoke over revolving surfaces. Patent 1606380. H. A. Pagenkoff, c/o Southern Gas Co., City National Bank Bldg., San Antonio, Texas.

MOTION-PICTURE-PROJECTING DEVICE.—In which the film is moved continuously at a uniform speed, thereby reducing flicker, and greatly facilitating the life of the film. Patent 1606002. G. B. Thorgney and H. R. J. Ahs, c/o G. B. Thorgney, 3844 Chicago Ave., Chicago, Ill.

CANDY VENDER.—Having means whereby candy may be displayed in different compartments on a revolving table, inaccessible to strangers, but readily accessible to the sales clerk. Patent 1604449. G. H. Koster, 44 Glen Ave., Oakland, Calif.

VALVE.—With means whereby leaking fluid in a gas or oil well may be confined until operations of the well will permit of a proper repair. Patent 1606715. W. J. Miller, c/o Vacuum Oil Co., Galveston, Texas.

SEWING MACHINE ATTACHMENT.—Including a roll holder for tape, means for feeding the tape and a gauge maintaining the edge of the tape and the material being sewed in alignment. Patent 1607532. S. Halberg, 728 Driggs Ave., Brooklyn, N. Y.

PORTABLE COAL TIPPLE.—By means of which the coal may be graded at the place where it is mined, and directly loaded into the cars utilized for shipment. Patent 1607105. G. C. Singer, Oakland City, Ind.

OIL-WELL PUMP.—Which reduces friction to a minimum, eliminates undesirable scouring of the plunger by the action of sand, and will efficiently pump at a great depth. Patent 1607025. R. B. and C. B. Thurston, Box 222, Oakdale, Calif.

CASING PROTECTOR.—Which prevents objects from falling down into a well during the drilling operation, yet permits the ready insertion or removal of the drill bit. Patent 1607430. H. C. Brewster, c/o Oil City Iron Works, Shreveport, La.

ROTARY HYDRAULIC WELL DRILL.—The drive shaft having a spiral provided with baffles upon which the weight and pressure of the fluid have an effect in turning the shaft. Patent 1607082. H. A. W. Howcott, 309 Balter Bldg., New Orleans, La.

SEALING RING FOR CAN-TESTING MACHINES.—A special ring which will go in place on the standard can-testing machine and give a more effective seal that is usual. Patent 1606486. G. M. Stevens, 938 Harrison St., San Francisco, Calif.

CUP-PISTON CONSTRUCTION FOR LUBRICATING DEVICES.—Which provides a leak-proof connection between the follower cup and the base, the oil being conveyed to the parts by compressed air. Patent 1607081. C. F. Hoofer, 549 W. Washington Blvd., Chicago, Ill.

PIPE-STEM-BIT MACHINE.—Constructed in such manner that the opposite ends of a piece of stock may be differently shaped by the action of the machine. Patent 1608374. J. R. Desjardins, 33 Webster St., Fall River, Mass.

Medical and Surgical Devices

MASSAGING DEVICE.—Having an action similar to that of the fingers and hand of an expert massagist, causing the pores to respond to the action of medical compounds. Patent 1604435. E. Wharton, 311 Pacific Bldg., San Francisco, Calif.

TONSIL REMOVER.—Whereby the tonsils will be quickly removed with little or no bleeding, thereby enabling a short anesthetic to be employed for the operation. Patent 1609014. J. E. Dowd, 1204 Deseret Bank Bldg., Salt Lake City, Utah.

KNIFE.—Such as employed by surgeons, whereby the same handle may at all times be used, but various blades may be quickly connected therewith. Patent 1608781. G. B. Efantis, Route 2, Hinsdale, Ill.

Prime Movers and Their Accessories

AIR MOISTENER FOR INTERNAL-COMBUSTION ENGINES.—Of such nature that the moisture laden air after having passed through will contain but a very small amount of foreign matter such as dust. Patent 1606472. A. J. and D. W. Kieffer, Hot Springs, S. D.

ENGINE.—Having blades which draw in and compress combustible charges in one chamber, and similar but reversely positioned blades in a second chamber, operating as both internal and external combustion engines. Patent 1605912. S. T. Barker, Box 1066, Manila, P. I.

MOTOR.—In which the fuel mixture will be so distributed that no danger of an explosion flashing through the combustion chamber or crank case will exist. Patent 1607431. J. F. Brice, 665 5th Ave., New York, N. Y.

AIR STARTING VALVE.—Which is substantially automatic in operation, suited for practically all types of internal combustion engines but primarily for the Diesel type. Patent 1608459. D. O. Barrett, R. D. No. 4, Springfield, Ohio.

SELF-GRINDING VALVE.—Providing a mechanism operable by the lift movement of one valve for imparting turning movement to an adjacent seated valve to set up a grinding action. Patent 1607555. F. J. Monaghan, 102 Smith St., Perth Amboy, N. J.

CHARGE-MODIFYING METHOD AND APPARATUS FOR INTERNAL-COMBUSTION ENGINES.—Whereby a solid explosive fuel modifying substance, in dust form, may be admitted to the combustion chamber along with the usual gaseous charge. Patent 1605342. W. Goodfellow, 342 Lester Ave., Oakland, Calif.

Railways and Their Accessories

CAR REPLACER.—Which affords facilities for guiding the wheels of a derailed car onto the rails without appreciable strain on the replacer, rails or car. Patent 1606371. W. M. Kitchen, General Delivery, Baltimore, Md.

STOCK-CAR GATE.—Or partition, which may be selectively moved to divide a stock car into stalls or compartments, or act as a closure for the doorway. Patent 1605822. N. J. Eldridge, c/o W. P. Mullen, Grand Island, Neb.

RAIL TIE PLATE.—Organized with the tie in such manner as to resolve the pull on the rail spike into a lateral instead of the usual vertical pull. Patent 1609109. R. A. Bradley, 24 Canal St., Merritton, Ontario, Canada.

RAILWAY SWITCH.—Constructed to increase the stability and durability of switches, frogs and the like without adding to the complexity, material, or installment costs. Patent 1608121. M. S. Housken, 464 29th St., San Francisco, Calif.

Pertaining to Recreation

TOY VEHICLE.—Wherein accommodation is provided for several children, and one of the children may propel the vehicle, or a person walking may pull it. Patent 1607402. T. G. Leonardi, 427 Greene Ave., Brooklyn, N. Y.

TOY CART.—Of the type which is propelled by pushing on the ground, imitating a canoe being paddled, the steering being accomplished by the feet. Patent 1607958. A. J. Koehler, 5310 S. Laflin St., Chicago, Ill.

ROLLER SKATE.—Having unique mechanism for preventing the retrograde rolling movement of a wheeled carriage while permitting free forward rolling movement. Patent 1608368. O. T. Bugg, Holland Hotel Bldg., Beacon, N. Y.

SWING TOY.—Comprising a supporting structure, seats and a top, capable of being produced, mainly from blanks of light metal, at a minimum expense. Patent 1609224. E. H. Tunley, c/o Pickwick Mfg. Co., 129 Patchen Ave., Brooklyn, N. Y.

CHECKER SHOOTER.—For propelling game pieces, such as disks, marbles, or for sundry other purposes, without requiring the players to get down on hands and knees. Patent 1609247. F. J. Hanley, 71 East End Ave., New York, N. Y.

WALKING TOY.—In imitation of a bird, which when pulled forwardly will simulate in a grotesque manner the swaying walk of a duck. Patent 1605307. J. E. Walker, 610½ W. 7th St., Sterling, Ill.

Pertaining to Vehicles

CHAIN FASTENER.—Which is rugged and may be applied with facility, for attaching cross tread members of a tire chain to the annular rims thereof. Patent 1606672. S. Stamirowski, 323 E. 150th St., New York, N. Y.

TIRE AND TOOL CARRIER.—A box-like holder either secured to the frame or forming an integral part of the rear portion of the automobile body. Patent 1606351. D. H. Donachy, 952 Memorial Ave., Williamsport, Pa.

DEVICE FOR OPENING LAMP DOORS.—Which may be quickly applied to the outer surface of a headlight door and turned to loosen the door upon the lamp casing. Patent 1606250. P. Lavold, R. F. D. No. 6, Viroqua, Wis.

STARTING AUTOMATIC DEVICE FOR AUTOMOBILES.—Which provides convenient means for starting the engine in case of a stall, especially in heavy traffic where time is limited. Patent 1607497. L. M. Williams and C. J. Jewett, c/o Charles J. Jewett, 700 North 12th St., Fort Smith, Arkansas.

LOCK FOR TRANSMISSIONS AND OTHER PURPOSES.—A combination lock which is extremely difficult for an unauthorized person to remove, or to solve the numerous combinations thereof. Patent 1607426. H. V. Bell and H. E. Eastman, c/o H. V. Bell, 681 5th Ave., New York, N. Y.

OIL CUP.—For various bearings of automobiles, may be positioned at any angle made necessary by the parts to which the cup is applied. Patent 1607523. F. J. Gaffney, 42 W. 61st St., New York, N. Y.

AUTOMOBILE VENTILATOR.—Susceptible of incorporation in the structure of closed cars, and will effectively remove gases and foul air without causing drafts. Patent 1607109. F. E. Wieser, 1009 Monterey St., San Luis Obispo, Calif.

DIRIGIBLE HEADLIGHT.—Wherein either or both lights may be turned to play upon the road when rounding a curve, or one may remain stationary, the other following the curve. Patent 1607349. T. C. Holliday, 306 Edward's Hotel, Jackson, Miss.

RADIATOR.—With curved heat radiator fins, causing the air to take a circuitous path as it passes through the radiator, providing more effectual heating. Patent 1607093. DeWitt T. Lyon, Buena Plaza Apt., 4363 Kenmore Ave., Chicago, Ill.

FRONT WHEEL BRAKE.—Which will give the operator greater control of his machine, and whereby the wheels may be swung about vertical axes without operating the brakes. Patent 1607665. W. Cooper, c/o J. A. Marck, 5 Main St., Flushing, N. Y.

PULLING DEVICE.—Capable of universal application for pulling one object from another, especially the removal of wheels from the axle of a shaft. Patent 1607957. A. J. Koehler, 5310 S. Laflin St., Chicago, Ill.

COMBINED SLED AND WAGON.—Quickly changed to either conveyance, and wherein a person may run between the sides at the rear and jump to a platform near the center. Patent 1608378. C. Engel, 153 E. 54th St., New York City.

HYDRAULIC BRAKE.—Whereby great pressure may be brought to bear with little manual effort, and wherein the brake linings may be easily replaced. Patent 1608568. F. C. Shepley, Box 494, Hominy, Okla.

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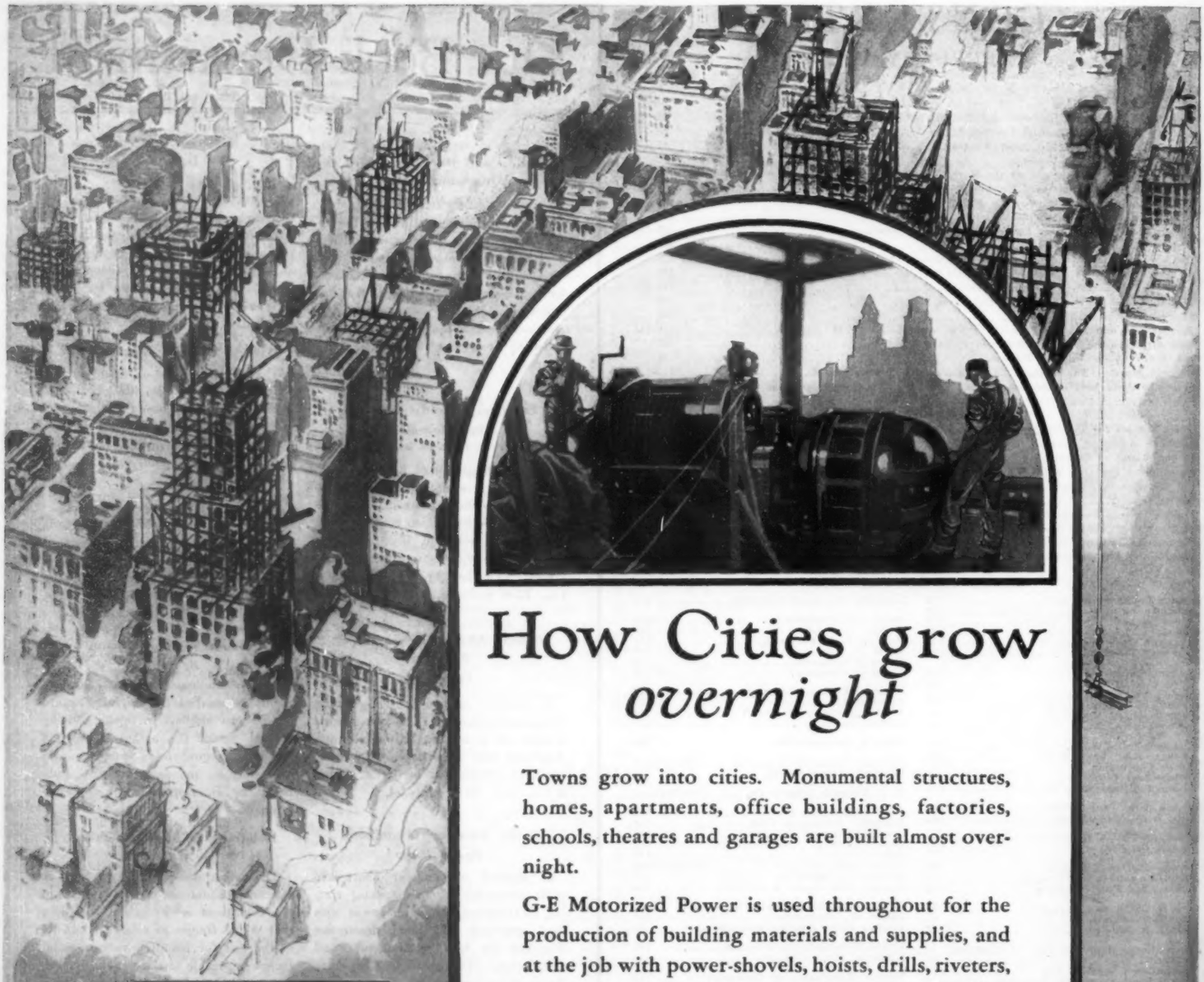

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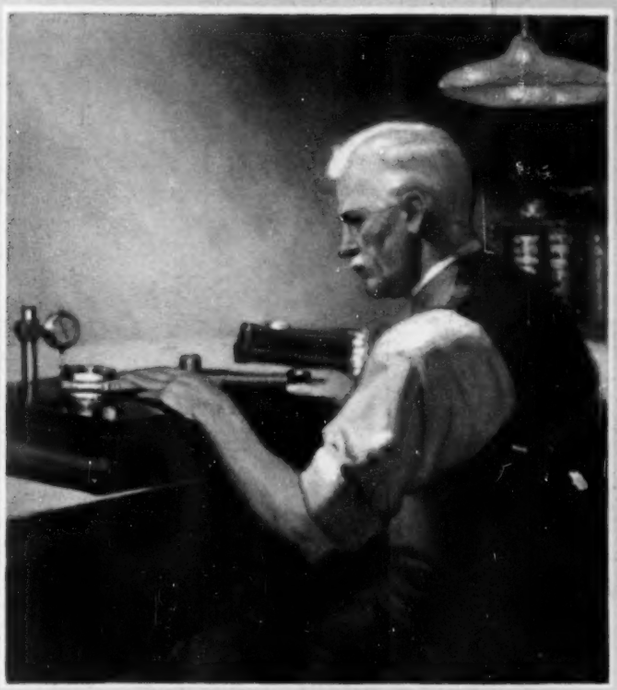

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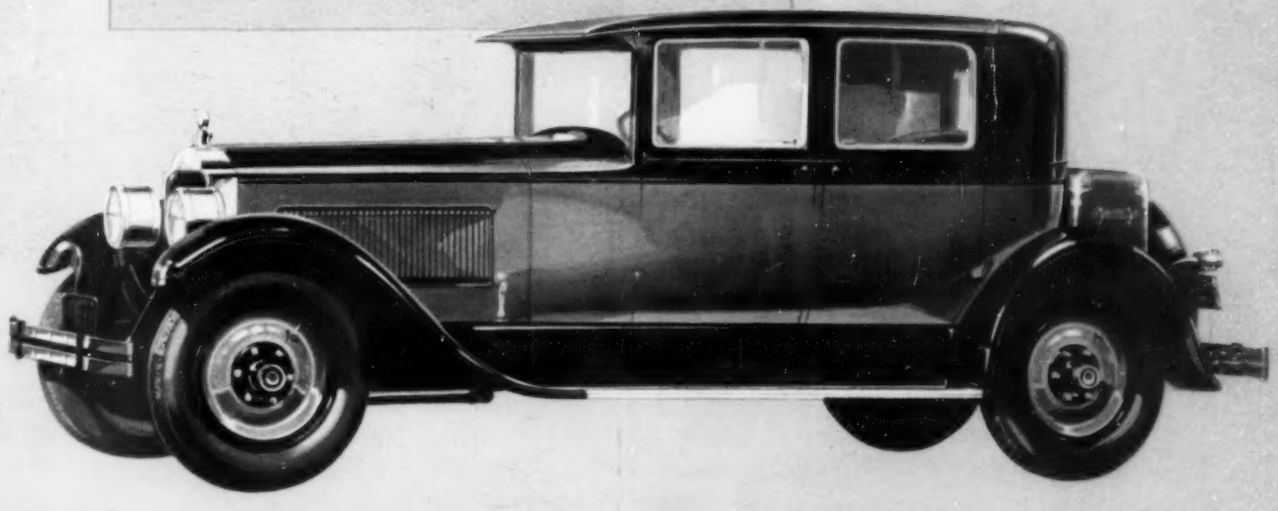

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